

INTERFACETM



MICROCOMPUTING FOR HOME AND SMALL BUSINESS VOL. 2, ISSUE 8, JULY 1977 \$1.75

INTERNATIONAL \$3.00

Floppy ROM Update

Microcomputer Lock

Diablo Output
Driver Routine

SPECIAL DIRECTORY ISSUE

SWTPC announces first dual minifloppy kit under \$1,000



Now SWTPC offers complete best-buy computer system with \$995 dual minifloppy, \$500 video terminal/monitor, \$395 4K computer.



\$995 MF-68 Dual Minifloppy

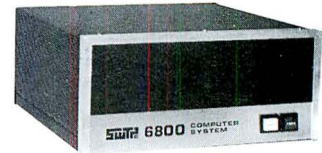
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional \$850 MF-6X kit expands the system to four drives.



\$500 Terminal/Monitor

The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is \$325, the 12 MHz CT-VM monitor \$175.



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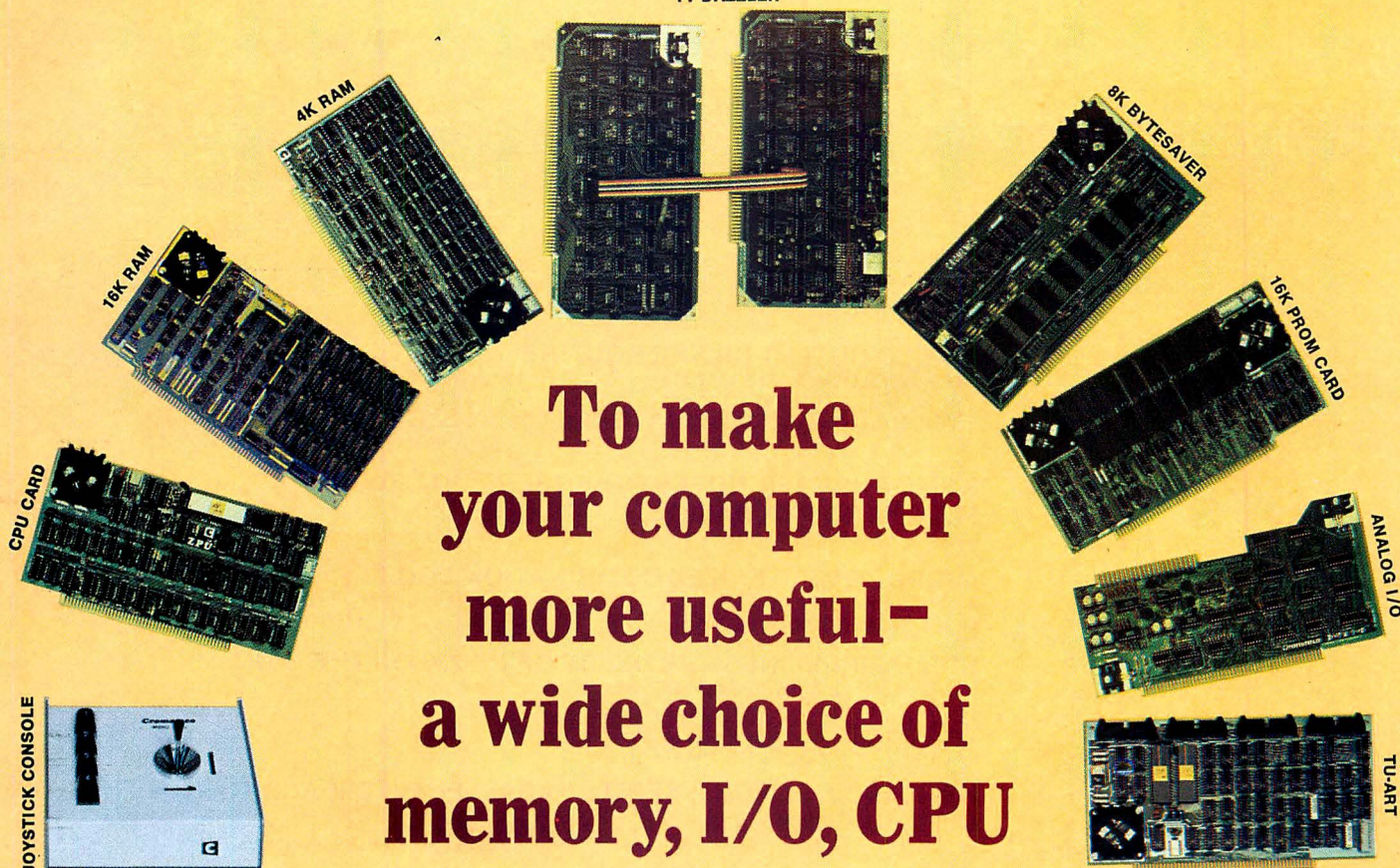


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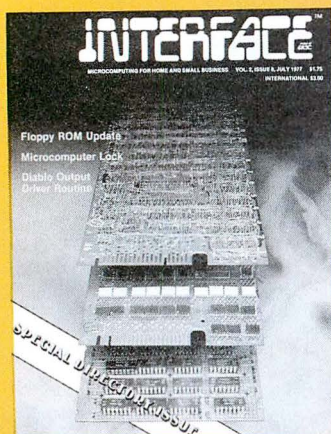


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Photography by Jim Hansen

COVER STORY

The cover photo depicts an array of high density electronic packaging techniques, including stitch-bond welding, parallel gap welding, and DIP socket pins. These techniques, not totally applicable to hobby computers, exemplify the processes that companies utilize in the business and military marketplace.

This photo was provided by Multi Link, an advanced electronic packaging service firm that specializes in these processes, with such clients as NASA, IBM, Rockwell, and many others.

For more information on these techniques, contact: Dick Vanderpool, General Manager of Multi Link, 2121 S. Manchester Boulevard, Anaheim, California 92802, (714) 634-1178.

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MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

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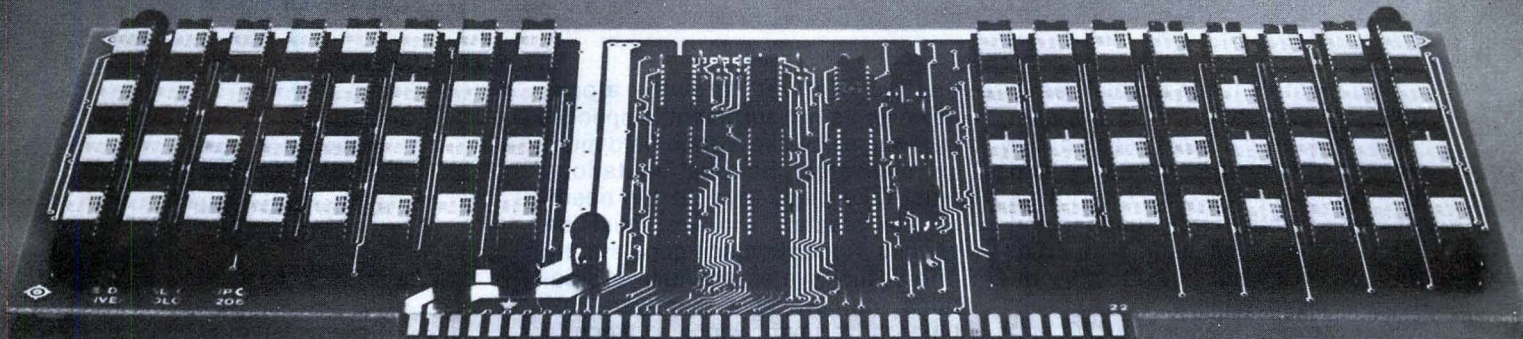
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INTERFACIAL



This month's issue specializes in hardware and software. In the past three months we have regaled our readers with exotic, whimsical and intellectual endeavors. Now it is time for a return to the mundane and practical; hence an issue devoted to reference matters, "how-to's", products and procedures.

Bob Stevens tried a DIABLO and liked it so much that he comments upon the routine in his software editorial.

In the May issue we solicited replies on the FLOPPY ROM experiment. Most of the mail was positive. Several letters expressed the opinion that a vinyl disc insert was the most suitable way to market software. We had had apprehensions about the condition of the platter after its gauntlet run through the mails, but the number of damaged copies returned and replaced was negligible. William Blomgren, however, followed up on his article with a short sequel in which he discusses life expectancy of the disc and offers some adjustments which our readers who have experimented with the device may find helpful.

With each passing month designers are finding new applications for the versatile little microprocessor. We plan to publish these new applications as fast as our press procedure will allow. The MICROCOMPUTER COMBINATION LOCK is one such application.

For the unseasoned hobby computerist, one of the most confusing aspects of microcomputing involvement is correct connection: which pin goes into which socket. Michael Duncan sets down some simple fundamental rules on articulation. We suspect that our readers will be making photocopies of SOME GUIDELINES FOR THE USERS OF THE RS-232 OR THE UART. We would rather that you buy an extra copy of our magazine, but sadly we must admit we can't have it all our way.

INTERFACE AGE is growing proportional to the growth of the in-

dustry. Natural growth alone, however, is not sufficient; a specialized magazine like a grain field must be *cultivated*. Editorial mutations must take place to meet the needs of the readers and we must be *spunky*. Roger Edelson consistently offers the system builder evaluations on available hardware. At times advertisers wince at Roger's woodcut honesty. This time Western Digital and Cromemco are under the glass. Motorola has not escaped the beam either. Bill Sevedge spent some time with the soldering iron and reports on his experience with the 6800 Evaluator.

A fastidious computerist wants good housing for his kits. For those with a well-endowed checkbook this is no problem, the New Products Peripherals Section provides a show window for elegant merchandise. But what about the man or woman whose dedication to the art surpasses available spending power and who likes a neat environment? Tom Balph and Dick Spurgeon provide an answer: build elegant housings from scrap PC board. It saves money and gives the satisfaction of recycling valuable material. Being frugal can be fun.

More fun is found in the back of the book. Bud Shamburger shows you that all work and no games makes even an Altair™ a dull computer. After a hard week's work doing their innkeeping tasks, man and machine relax with a game of BOWL.

In the May issue we called for reader letters and are happy to say that you have responded liberally with constructive criticism, praise and involvement. We shall publish these letters, editing from them only clerical or bookkeeping material. We mention this now because your letters are so complimentary that we project our own suspicions that the ellipses might have contained derogatory material conveniently deleted. That would only happen, be assured, if the language is unprintable; and that is a seldom occurrence. Readers, continue being writers.

—L.F.S.

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Milwaukee, WI 53213
(414) 259-9140

CANADA

Trintronics
160 Elgin St.
Place Bell Canada
Ottawa, Ontario K2P 2C4
(613) 236-7767

First Canadian Computer
Store, Ltd.
44 Eglinton Ave. West
Toronto, Ontario M4R 1A1
(416) 482-8080

The Computer Place
186 Queen St. West
Toronto, Ontario M5V 1Z1
(416) 598-0262

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Now for only \$995 in kit form or \$1495 fully assembled and tested you can have your own small computer with perhaps even more power. It comes in a package about the size of a typewriter. And there's nothing like it on the market today. Not from IBM, Burroughs, DEC, HP or anybody else!

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If you're an engineer, scientist or businessman, the Sol-20 can help you solve many or all of your design problems, help you quantify research, and handle the books too. For not much more than the price of a good calculator, you can have high level computer power.

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Sol-20 is a smart terminal for distributed processing. Sol-20 is a stand alone computer for data collection, handling and analysis. Sol-20 is a text editor. In fact, Sol-20 is the key element of a full fledged computer system including hardware, software and peripheral gear. It's a computer system with a keyboard, extra memory, I/O interfaces, factory backup, service notes, users group.

It's a computer you can take home after hours to play or create sophisticated games, do your personal books and taxes, and a whole host of other tasks.

Those of you who are familiar with small computers will recognize what an advance the Sol-20 is.

JULY 1977

Sol-20 offers all these features as standard:

8080 microprocessor — 1024 character video display circuitry — control PROM memory — 1024 words of static low-power RAM — 1024 words of preprogrammed PROM — built-in cassette interface capable of controlling two recorders at 1200 bits per second — both parallel and serial standardized interface connectors — a complete power supply including ultra quiet fan — a beautiful case with solid walnut sides — software which includes a preprogrammed PROM personality module and a data cassette with BASIC-5 language plus two sophisticated computer video games — the ability to work with all S-100 bus products.

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Processor Technology, Box G, 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.



CIRCLE INQUIRY NO. 44

INTERFACE AGE 7

LETTERS TO THE EDITOR

Dear Editor:

As both a professional disc jockey and part-time computer hack, I was very interested in Robert Cheeseboro's article describing his COMPUTRAC 2000 Microprocessor-controlled record player, which appeared in the May, 1977 INTERFACE AGE.

As much as the unit described intrigues me, however, I wonder how far away it is from being a real product. Cheeseboro's prose and promotional talents cannot be faulted, but nowhere in the article can I find a target market date, a target retail price, or any other indication that the COMPUTRAC 2000 is any more than a clever mock-up and a batch of convincing technical drawings.

If the COMPUTRAC does indeed exist in solid reality, and is a feasible and soon-to-be marketed product, please forward this letter to Mr. Cheeseboro with my apologies and admiring compliments. In the case it does exist, I would like to receive more information along the lines mentioned above: a tentative marketing date, a target retail price, and, most importantly, the *audio* performance specifications of the unit. It is this last set of data (and the proof of it in actual performance) which will decide the commercial success or failure of COMPUTRAC. Its various and sundry programming features will not save the unit in the face of less than acceptable audio performance.

At least you should have printed an address for Cheeseboro Products Corporation so that I might have contacted the manufacturer directly.

While the COMPUTRAC article was generally well-written and very interesting, the lack of specific marketing information or adequate technical specifications for the unit described leaves me with dubious feelings toward COMPUTRAC, Cheeseboro, and INTERFACE AGE. I trust that future articles of this type will be more fully substantiated.

Jim Merritt
Berkeley, CA 94704

Did it again! The last time we left out an address, we received 152 calls and 37 letters. For those interested, contact Cheeseboro Products Corp., 11633 S. Alameda St., Los Angeles, CA 90059. (213) 776-3435 or (213) 678-3683. —Editor

Dear Editor:

For the past 7 years I have been conducting some personal research on belief in fatalism. I am in East Lansing Michigan on occasion and when there I try to run my data through the Michigan State University computer. To do this I give them a "grant" of several hundred dollars and then compete with the jams of students and other data going through their machine, sometimes waiting as long as three to five days to get my results. In total, this is amounting to some 'real' money.

The other day I was speaking to a man here who knows a little about the present state of affairs in computers (and if the new \$16.95 Sharp I just received this week is any sign of the present state of computers then what he says must be true), and he says that it is now possible to buy some pretty sophisticated hardware for prices under \$1,000.00 . . . in fact a good deal less than that amount.

If I give you an idea of what I want to do, can you send this letter (or a copy in case there are several) on to the manufacture of some of this type of equipment so I might see about buying a computer for my own? I would appreciate it no end.

I do social research (and am using the SPSS system at MSU). I now have my data on IBM punch cards and feed it in with the appropriate program. I need correlations, frequency counts, occasional item or factor analysis and most of all various analysis of variance systems and level of significance or confidence of the variances worked with.

My present punch card data is pretty well finished so if the machine has to have data in some other form, then this is no great problem for I will simply put the new data in the new form, whatever that is. I am working with samples and populations that number in the hun-

dreds, pretty much, although they run smaller rather than larger when they do vary. I doubt I will be working with populations over 500 very often.

If you can refer this to a possible supplier of systems that can help me I would be eternally grateful. There certainly is no help for me here in this cultural wasteland.

Jack Down, Ph.D.
American Cooperative School
Box 98, U.S. Embassy
Monrovia, Liberia, West Africa

Dr. Down received a personal reply. INTERFACE AGE would appreciate if readers and manufacturers would contact him directly. —Editor

Dear Editor:

In the latest INTERFACE AGE you mention that you are working on a program of TEXT EDITING SYSTEM for writing articles, letters, etc. This will be a boon to many people and will actually help sell many microcomputers. Please remember that as different from many such programs the ideal program is one that can be saved in cassette or disc so that one can read back the article from disc at a later date for further editing. The EDIT RUNOFF program of the General Electric ISBD Time Share is ideal in the respect and while perhaps a little too powerful for a small computer it would make an ideal target to strive for.

Dr. George L. Haller
Naples, FL 33940

Dear Editor:

Did the electronics company from which Mr. Loofbourrow obtained the very special wheels with which he powered his Robot swear him to secrecy regarding that source?

A few "Where to Buy" notes would be appreciated no end. Is it at all possible for we poor souls out here in reader-land to be apprised of such minor helps?

Not much use for you to go to all the research et al, about getting a build-it-yourself article and to ignore the things that are the most difficult for the would-be-builder.

A builder has to predicate his attempt on the few parts that are practically impossible to make himself, such as rubber wheels, and motors etc. After we discover what is available in those areas, we are safe to go ahead and build.

Lewis T. Ingraham
Costa Mesa, CA 92626

Tod Loofbourrow answers a previous request about these wheels below. —Editor

Dear Editor:

In response to Mr. Wills' question, the motorized wheels are available from: Herbach & Rademan, 401 E. Erie Avenue, Philadelphia, Penn. 19134 for \$11.00 each and 2/\$20.00 Order #TM20K370. They can run on six, or twelve volts D.C. I have sent a similar letter to him.

Tod Loofbourrow
Westfield, N.J.

Dear Editor:

My name is Scott Dresden and I am 12 years old. I have been dying to get a computer of my own since I started a course at my school. Could you tell me a computer that I should get that is very cheap, has everything I need and includes a lot of storage?

Scott Dresden
St. Petersburg, FL 33705

We don't want to recommend one over the others. Look at the OEM Supplement and Pricelist, page 76, to help you decide. Readers, how about giving the lad some ideas?

—Editor

Dear Editor:

Help! My March issue of INTERFACE AGE arrived late and in terrible condition. The post office appears to have used it for a skate-

board. Can you send me an intact copy?

Darryl Kuhns
Reno, Nevada 89502

Hope you've received the replacement in better condition. —Editor

Dear Editor:

I am a Ham in Tokyo and have imported several ham gears from U.S.A. I am also interested in computers, for they fascinated me in college. I played with Hitac 10, Melcom 70, Nova and Facom minicomputers. Now I am very pleased with personal computer age and eager to see your subscription.

M. Egawa
Nerima, Tokyo, Japan

Dear Editor:

I enthusiastically support your floppy ROM idea. I'm building my interface now. Please distribute lots of Z-80 software this way.

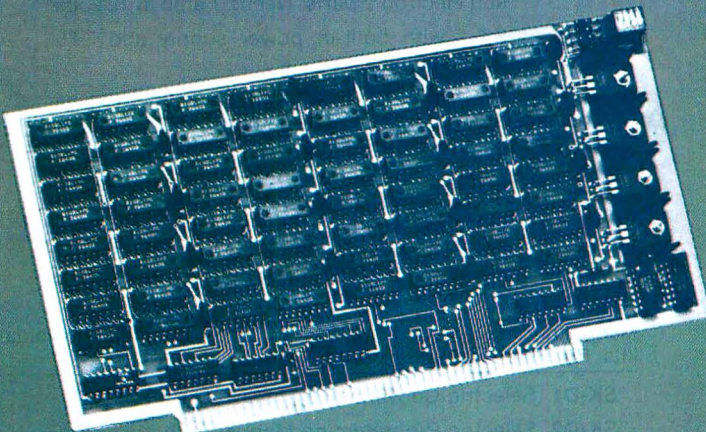
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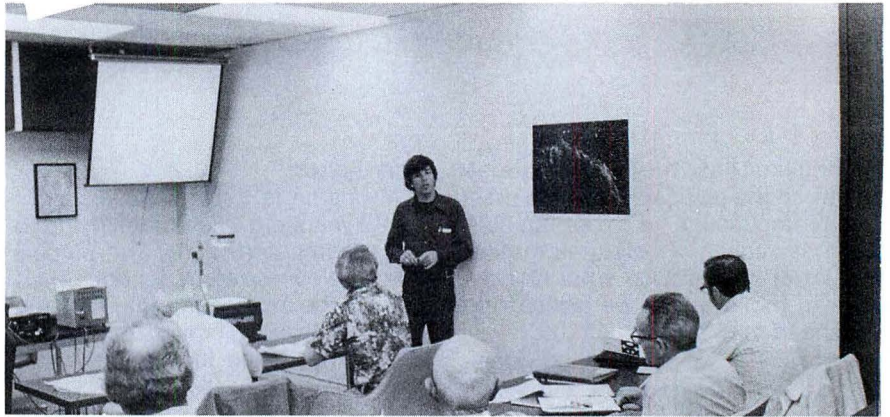
UPDATE

CLASSES IN BASIC AND 8080 ASSEMBLER

Computer Power & Light offers a series of regularly scheduled classes in BASIC and 8080 assembler programming at its educational facility in Studio City, California. These small, colloquium-style classes feature significant "hands on" experience using the five systems always available to students. By using a large screen demonstration computer and overhead transparencies-maker, the instructor can demonstrate and discuss new material and students' programs with maximum effectiveness.

The BASIC class, which meets either two evenings each week for four weeks or once a week for eight weeks, covers all the elements of writing, documenting, de-bugging and using applications programs.

The Assembly Language class meets on Saturday mornings for eight weeks, and emphasizes programming skills and the construction of flexible, standard, well-documented machine language routines.



All instructors are experienced educators and first-rate programmers—no technical or sales people "pressed into service"! Fee of \$100, includes all texts, materials and computer time. For further information contact Computer Power & Light Inc., 12321 Ventura Blvd., Studio City, CA 91604, (213) 760-0405.

CALL FOR PAPERS

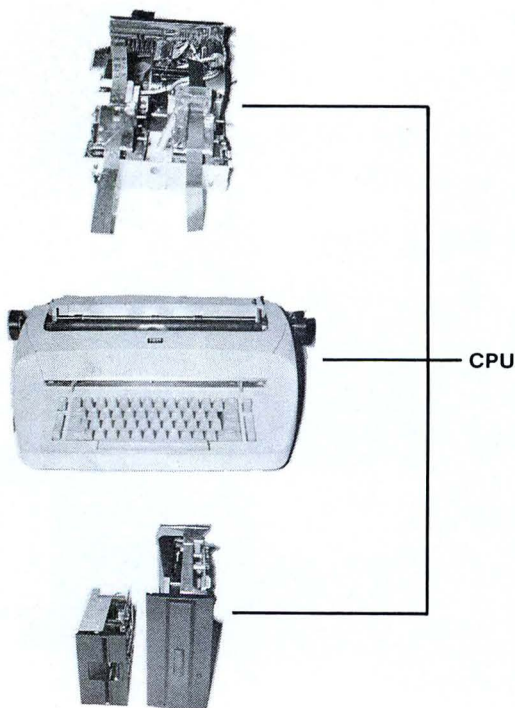
MIMI '77 MONTREAL, November 16-18, 1977 will be held at the Queen

Elizabeth Hotel, Montreal, Canada and is sponsored by ICORD, IEEE Region 7, The International Society for Mini- and Microcomputers. Requested are 200-250-word abstracts to be submitted by September 1, 1977 to the Symposium Chairman, Prof. J. K. Houle—MIMI '77, Ecole Polytechnique, Case Postale, succursale A, Montreal, Quebec, Canada H3C 3A7.

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Item	Description	Price
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SK-2	SK-1 with built-in power supply and TTL compatibility	215.00
SK-3	SK-2 with controller kit giving RS232 serial ASCII data at 110 or 300 BPS. A high speed paper tape interface is included	389.00
DK-1	Floppy disk and controller kit, with 350 KB drive. For use with SK-3, or any serial interface, up to 19200 BPS. Contains high level DOS, with simple commands making any terminal a smart one or any serial CPU a disk system	795.00

Manuals from above kits are offered for the purpose of evaluating the kits. Refunds for manuals apply on subsequent kit order.

SK-D1	Selectric Conversion Manual	6.50
SK-D2	Selectric Programming Manual, with listings and timing data	6.50
DK-D1	Floppy Disk Kit & DOS Manual	6.50

Shipping date 1-3 weeks after arrival of order.



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ACT 1: Our story begins with the ACT-I terminal—the world's first Affordable Computer Terminal. The ACT-I is an exceptionally practical interface between man and machine for any computer system which communicates over a serial ASCII link. Whether querying a microprocessor based system or time-sharing on a major computer net, the ACT-I is the most economical method of alphanumeric communication at data rates from 110 baud all the way to 9600 baud. The ACT-I video computer terminal manages a 1024 character display memory organized as 16 lines of 64 characters chosen from the standard upper case ASCII set. Receipt of more than 64 characters on a line or the 'CR' code initiates a scroll operation. The entire screen may be locally cleared at any time by depressing the 'CLEAR' key.

I/O SPECIFICATIONS (JUMPER SELECTABLE):

DATA RATE: 110, 300, 600, 1200, 2400, 4800, 9600 BAUD

PARITY: odd, even, or none

STOP BITS: 1 or 2

LOGIC LEVELS: RS232, TTL, or 20 ma loop

PRICE: \$400



ACT 2: The plot thickens. For remote communication to a central processor MICRO-TERM introduces the ACT-II. The ACT-II includes all of the desirable features of the ACT-I with the important addition of an integral originate—only 300 baud modem and acoustic coupler for a standard telephone handset. The ACT-II (without monitor) slips easily into a briefcase (4x14x11) and readily commutes with you.

The ACT-II's modem features 5 stages of active filtering as well as one passive stage to achieve the lowest possible error rates despite the noises present on Ma Bell's lines.

Want true CPU power for low cost? Investigate the time-sharing systems in your area; the ACT-II can be your key to the tremendous libraries of debugged, documented, software which are available on these dial-up systems.

PRICE: \$550.

ACT 3: Not to be upstaged by its exciting predecessors, the ACT-III performs with state of the art elegance and versatility. The ACT-III includes switch selectable display formats: 24 lines of 80 characters; 48 lines of 40 characters; or 96 lines of 20 characters. Transmission is also switch selectable between three modes: character, line or page at a time mode. The PRINT key sends the contents of the 1920 character display memory out an RS232C printer port at rates up to 9600 baud. For optimum efficiency, trailing spaces on any display line are excluded from transmission and of course the printer rate is independently switch selectable.

Full cursor control, direct cursor addressing, protected data fields, and video inversion are all standard encodeable functions. Convenience features such as a video monitor AC power outlet and a switch to initiate a comprehensive terminal self test are available on the cabinet rear. The ACT-III is the most complete video terminal available at a price far below that of the competition, smart and dumb alike.

PRICE: \$700.



GENERAL INFORMATION

All MICRO-TERM products are fully assembled, tested and guaranteed for 90 days. The MICRO-TERM product line is available from stock at discriminating computer stores or may be purchased directly from the factory (30-45 day delivery). Prices are F.O.B. St. Louis, Mo. excluding video monitors. Optional high resolution video monitors are available from the factory beginning at \$125.00.

BankAmericard and Master Charge accepted.



MICRO-TERM INC.
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ST. LOUIS, MO 63117

CALENDAR

UPCOMING COMPUTER SHOWS

- July 20 The IEEE Computer Society of Central Indiana will sponsor a microcomputer show. There will be exhibits, demonstrations, and technical seminars. For location contact Thurman Gladden, Show Publicity Chairman, (317) 353-3208.
- July 24-27 EXPO 77, Washington D.C., Marriott Twin Bridges Hotel. For further details, write: OCR Users Assoc., 10 Banta Pl, Hackensack, NJ 07601.
- July 24-29 International Computer Exposition for Latin America, Mexico City, Mexico.
- July 28-29 ACM Pacific '77, San Jose, CA, LeBaron Hotel. For further information write: Association for Computing, P.O. Box 60355, Sunnyvale, CA 94088 or call (415) 666-2334.
- August 8-12 IFIP Congress '77, Toronto, Canada. The Congress will be offering a full week of stimulating information exchange with developers and users of the most advanced computer techniques from some 35 countries. For your pre-registration kit write to: Robert Spieker, Registration Chairman, U.S. Committee for IFIP Congress 77, c/o AT&T, 444 Hoes Lane, Piscataway, NJ 08854.
- August 18 New England Computer Show. Featuring the latest in computer systems and peripherals for both the OEM and End-User markets. Newton, Mass. Contact Norm De Nardi Enterprises, 95 Main St., Los Altos, CA 94022 or call (415) 941-8440.

Recently I had a proposal from our editorial staff to discontinue the club calendar. I opposed the idea, and was told that updated information was not coming in at a regular pace. The newsletters tell only what has happened at the last club meeting—not what is going to happen in future meetings. Other mailings which we set out were returned too late for publication, or not returned at all.

In an attempt to satisfy the editorial staff, I decided to write a few ground rules for the clubs as well as for my editors:

1. Club meeting dates will only be published on a continuing basis, if we receive a monthly

letter giving dates and meeting places along with possible agenda information.

2. This information must be received at least two months before publishing dates. Example: Details mailed in July must have information for Sept. and Oct.
3. All other correspondence not received on a continuing basis will be published on a space available basis.
4. Information Required is:
 - a) Dates of meetings
 - b) Location of meeting—Complete address and/or directions
 - c) Meeting Agenda
 - d) Persons to contact for further information (in column)
 - e) Phone number and Mail address including Zip Code
 - f) Any other notables of interest (optional)

This editorial is an attempt to determine the level of interest and response in regards to the Calendar section. I will re-evaluate this column at a future date, as a follow-up to the editorial proposal. —Editor

CALENDAR

- July 2 Milwaukee Area Computer Club will meet at 1 PM at the Waukesha County Technical Institute, New Berlin, WI. Call (414) 246-6634 for further details.
- July 2 Louisville Area Computer Club meets at 1 PM in the Speed Auditorium at the University of Louisville, KY. Call Glen Darwin at (502) 456-5589.
- July 2 South Central Kansas Amateur Computer Association meets at 9AM at Downtown Public Library, Wichita, KS. Contact Cris Borger at (316) 265-1120 for club agenda.
- July 2 Ventura County Computer Society (SCCS) meets at 7:30 PM at the Camarillo Public Library located at 3100 Ponderosa Drive, Camarillo, CA. For more details, Write: VCCS, P.O. Box 525, Port Hueneme, CA 93041 or call (805) 985-2631.
- July 6 Northwest Computer Club will be holding its meeting at 7 PM at the Pacific Science Center, Room 200, located in North Seattle, WA.
- July 6 Homebrew Computer Club meeting will begin at 7 PM in

Menlo Park, CA. The Stanford Linear Accelerator Center Auditorium is the site of the meeting. Call (415) 967-6754 for details.

July 6 SCCS Valley Chapter will be holding its meeting at the Harvard School at 7 PM. The Harvard School is located at 3700 Coldwater Canyon, Studio City, CA.

July 6 Amateur Computer Society of Columbus will meet at 7:30 PM at the Center of Science and Industry. For further info call Fred Hatfield, President, (614) 486-3347.

July 7 Bay Area Microprocessors Users Group (BAMUG) will meet at 7:30 PM at the Hayward ROC Center, 26316 Hesperian Blvd. and Jackson St., Hayward, CA. Contact BAMUG, 1211 Santa Clara Ave., Alameda, CA 94501 for further information.

July 8 Crescent City Computer Club will hold its meeting at the University of New Orleans, Lakefront Campus at 8 PM. Call Bob Latham at (504) 722-6321 for more information.

July 8 Northern New Jersey Amateur Computer Club (NNJACC) will hold its meeting at the Fairleigh Dickenson University, on the Rutherford Campus, Becton Hall, Room B8. This meeting will begin at 6:30 PM. For more information contact: NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

July 9 Oklahoma Computer Club will hold its meeting at the Belle Aisle Library at 10 AM. Call Al Campbell at (405) 842-4933 for details.

July 9 The Permian Basin Computer Group-Odessa Chapter meets at 1 PM in the Electronic Technology Building, Room 203, on the Odessa College campus. For further information call (915) 332-9151.

July 10 North Orange County Computer Club will have its meeting at California State University, Fullerton. For more details on time and room call Lorin Mohler at (714) 998-5831.

July 10 South Eastern Michigan Computer Organization will hold its meeting at the studios of WJBK-TV-2 at 6 PM. Contact Dick Wier at 565-3228 for more information.

BRANCH TO PAGE 156

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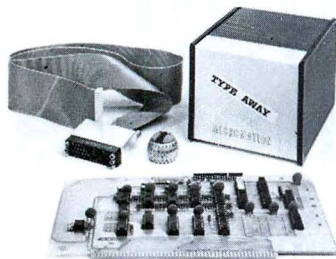
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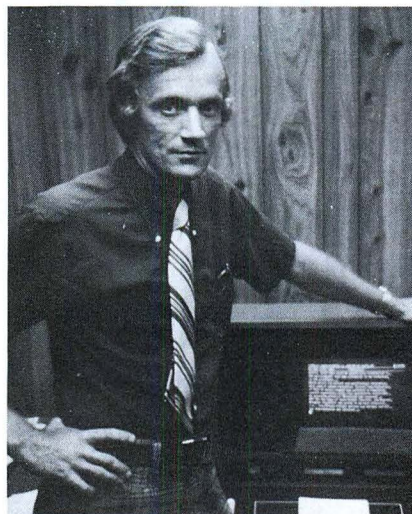
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CIRCLE INQUIRY NO. 26

SENSE LINE

Bill Sevedge



Newsletter articles are as elusive as butterflies. You can see the potential subjects and authors, but find it difficult to "get them bagged." If there was a secret to obtaining stories, I wouldn't be writing about it. Magazines, newspapers, and even newsletters have experienced the dreadful feeling that you don't have enough to fill the issue.

Why do authors write? Is it because of their need for self-esteem? ego? seeing their literary work in print? It is difficult to answer because differences in people and their personal needs. Whatever is an author's reason to write, the final objective is knowledge or views transferred from one mind to another. Written communication is very effective and lasting.

What does all of this have to do with a club newsletter? A newsletter striving to stay alive will experience the same growing pains that many of the major publications have suffered. Let's consider what you plan to accomplish with your newsletter. What is the objective of your publication? How many pages are to be printed? What can you afford to print? Who's going to pay for it? readers? and/or advertising merchants? What do your readers expect? Once you have these questions answered, it will be easier to

determine how many articles you will need for each month.

A common question asked is "How do we get articles?" As many editors have found out, there are more negative responses than articles received. Generally, a person will have a good idea or project, but claims "I'm not a writer." Don't be discouraged, invite him to put his idea or how his project was accomplished in his own words. This need not be in a form suitable for printing. The main point is to get his thoughts on paper, then re-write the article into the proper format, using his material. An alternate plan for acquiring an article is to interview a person on tape, asking questions that would be helpful and interesting to your readers. This works well on non-technical material such as programming techniques and general interest stories.

Articles from trade publications and other magazines or newspapers generally must have written notice for re-print permission. If you need fill-in material usually the trade publications have interesting short stories that perhaps your readers would not have the opportunity to see otherwise. Again I repeat, these articles for reprint require permission and acknowledgement in the re-printed article.

When INTERFACE AGE started, the editorial staff worked diligently to acquire articles which we felt would be beneficial to our readers. Author encouragement and positive attitude (don't beg), along with much re-writing kept the issues coming. Since then, we have built an article library, which has caused the tension to ease, but the pressure to get those elusive butterflies continues.

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OSBORNE AND ASSOCIATES, INC. August 26 & 27

"MICROPROCESSORS — WHERE THEY CAME FROM AND WHERE THEY ARE GOING. AN ANALYSIS OF ALL PRODUCTS ON THE MARKET TODAY."
Dr. Adam Osborne will present a 6 hour seminar covering topics such as; Bringing order out of chaos; All microprocessors are not equal — each serves one market better than the other; Identifying those markets best suited to each microprocessor; Real sales volume anticipated for 1977; Comparisons including; 8085 vs. Z80, 8048 vs. F8, Etc.
For information and reservations contact: Osborne and Associates Inc., Dept. PC77, P O Box 2036, Berkeley, CA 94702 (415) 548-2805.

SYBEX INCORPORATED Thursday, August 25 & Sunday, August 28

INTRODUCTION TO MICROPROCESSORS
This intensive seminar is intended for all non-specialists who wish to acquire a broad understanding of the basic concepts and advantages of microprocessors. It explains how microprocessors work and it stresses methods, costs, advantages and disadvantages for the most important application areas of each type of microprocessor. What is needed to implement a system; how to use it; the impact on microprocessor-based systems; their evolution. Topics covered include: BASIC DEFINITIONS, SYSTEM COMPONENTS, MICROPROCESSOR APPLICATIONS, WHAT TO LOOK FOR, and IMPACT AND EVALUATION.
PROGRAMMING MICROPROCESSORS
This seminar describes in detail the internal operation of a microprocessor system including how instructions are fetched and executed, how programs are written and executed in typical cases (arithmetic and input-output). The goal of this course is to provide an overall understanding of the basic concepts of microprocessor programming. Requires an understanding of the main concepts in the INTRODUCTION TO MICROPROCESSORS course. It is recommended that these two seminars be taken together.

Friday, August 26 MICROPROCESSOR APPLICATIONS

This seminar presents in detail the main application techniques of microprocessors. Topics covered include INTRODUCTION TO MICROPROCESSOR SYSTEMS, APPLICATION TECHNIQUES, CASE STUDIES (industrial applications, medical and business applications, microprocessors in the home, and others), and EVOLUTION.
For information and reservations contact: Sybex Inc., 2161 Shattuck Ave., Berkeley, CA 94704 (415) 848-8233.



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PRE-CONVENTION PROFESSIONAL SEMINARS

August 22-26 Technical Design Labs and Trenton State College Z80 Seminars at nearby Trenton State College.

Five software and four hardware seminars.

August 25, 26, 28 SYBEX Seminars at the Shelburne Hotel. Three intensive seminars: Introduction to Microprocessors, Programming Microprocessors, Microprocessors Applications.

August 24, 25, 26 TYCHON INC. Microcomputer Interfacing Workshop at the Shelburne Hotel.

August 26, 27 Osborne & Associates Microprocessors — Where they came from and where they are going, an analysis of all products on the market today. At the Shelburne Hotel.

MORE NEW PRODUCTS THAN EVER!

All the products you've been reading about in the ads will be on display at PC '77. Many companies will be showing exciting new products. HEATH COMPANY will display exclusively, for the first time, their complete computer line. SOLID STATE MUSIC, POLYMORPHIC SYSTEMS, THE DIGITAL GROUP, THOMAS INSTRUMENTATION, MOS TECHNOLOGY, TECHNICAL DESIGN LABS, SOUTHWEST TECHNICAL PRODUCTS, CROMEMCO, E & L INSTRUMENTS, THE INTERPRING GROUP, KENT-MOORE INSTRUMENTS, PERSCI INC, GEORGE RISK INDUSTRIES, MID WEST SCIENTIFIC, OSBORNE AND ASSOCIATES, EXPANDOR, QUAY CORP, MATRIX PUBLISHERS, CAMELOT PUBLISHING CO, HAYDEN BOOK CO, GAW ELECTRONICS, ENCLOSURE DYNAMICS AND SOROC TERMINALS will all be showing new products. Plan to attend!

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This is an annual award presented to a person who has given outstanding service to others in the personal computing field with no commercial motives. Nominations are currently being accepted from individuals and clubs.

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PROGRAMMING ENIAC by Mrs. John Mauchly
SAM 76 by Claude Kagan of Western Electric Co., an interactive symbol system manipulations system which grows with the user.
TELECOMMUNICATIONS FROM THE TERMINAL USER'S VIEWPOINT by David L. Peters of Vadic Corp.
INTRODUCING THE HEATHKIT COMPUTER PRODUCTS by Lou Frenzel of Heath Company
HOW MICROPROCESSORS ARE DESIGNED by Will Mathys of MOS Technology
THE FUTURE OF MICROS IN MEDICINE by Dick Moberg, Dept. of Neurosurgery, Jefferson Medical College, Philadelphia
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SHOULD MICROS BE USED FOR BUSINESS APPLICATIONS? by Frank J. Ponzio, Jr., of Mini Computer Suppliers, Inc.
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MICROPROCESSOR APPLICATIONS FOR RADIO AMATEURS by Kasser G3ZCZ of AMSAT
WHAT PEOPLE ARE NOT GOING TO DO WITH HOBBY COMPUTERS by Stephen Gray of Creative Computing
APPLICATIONS OF MICROCOMPUTERS: THE MYTH AND THE REALITY by David Ahl of Creative Computing
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DYNAMIC DEBUGGING SYSTEM FOR THE 8080 CODE by Larry Stein and David Benevy of Computer Mart of New Jersey
MICROPROCESSORS FOR THE HOBBY MARKET TODAY AND TOMORROW by Dr. Adam Osborne of Osborne and Associates
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PC '77 NEWS

In-depth
Seminars,
lectures,
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Silicone Sea ... There's a new excitement in Atlantic City. With the advent of casino gambling \$800,000,000 is being invested by such companies as Caesar's International, Playboy, Penthouse, Bally Corporation, Resorts International, Loew's Corporation and many others in new hotel, restaurant and entertainment facilities. And of course all the old attractions of this famous resort remain, the miles of sandy beach with gentle surf, the clean, well run amusement parks, the boardwalk with its exotic shops and much more. All of this adds up to the perfect family vacation spot, easily reached in less than two hours driving time from Washington DC, Philadelphia or New York City.

There is parking for 20,000 cars within a three block area of convention headquarters. The convention hotel is right on the boardwalk. Hotel parking is for hotel guests only. Others park on near-by Pacific Avenue.

Club Booth ... Every computer club is welcome to participate with us at PC '77 at our gigantic club booth. Clubs may have members manning the booth to engage in non-commercial activities such as meeting new people from their areas, giving out club literature, newsletters, membership forms and signing up new members.

Helpful Hints for Getting the Most Out of the Show

1. Make a list of the companies that you particularly want to see.
2. Bring pre-gummed address labels with your address printed on them for exhibitor questionnaires, booth prize tickets and requests for information. This will save having to write your name hundreds of times and give you more time to get around the show.
3. Plan on returning to your room or car several times during the day to drop off literature and to change into a fresh pair of comfortable shoes.
4. Bring a good tape recorder, lots of spare batteries and tapes and record information, make notes, and record the seminars. (Recording of seminars is for personal use only, reproduction is prohibited.)
5. If you are planning to attend only one day, make that day Saturday. If you find you really need more time you'll be able to come back on Sunday.
6. Make hotel reservations early. Have them confirmed to save both time and disappointment.
7. Bring spare pencils, pens, and note paper.
8. Bring adequate identification in order to make purchases.
9. Be open minded when talking to exhibitors. Listen to what they have to say, you may learn something valuable.
10. Bring your camera, there will be much to photograph.
11. Remember that advance registration will save you from having to wait in line. Mail the coupon below today!

Dr. John Mauchly and ENIAC ... Enthusiasts will have a chance to meet one of the earliest pioneers of the computer industry. Dr. John Mauchly, co-inventor of ENIAC, the first electronic digital computer, will be a featured speaker and guest at PC '77. Dr. Mauchly will be telling the inside story of the trials and tribulations, as well as the triumphs, of ENIAC. And remember, all of this was going on during World War II! Accompanying Dr. Mauchly will be Mrs. Mauchly who worked on the project as one of the original woman computer programmers. Dr. Mauchly, who is an active home computerist, will be available to speak informally with hobbyists during the convention. **Don't miss this!**

Club Hospitality Suite ... The Amateur Computer Group of New Jersey, Northern New Jersey Amateur Computer Group, Philadelphia Area Computer Society and the Chesapeake Micro Computer Club will host a hospitality suite during the show. Representatives of all computer clubs are encouraged to drop by the suite during the show to exchange views, greet old friends and meet new ones.

SPECIAL GROUP TRAVEL RATES ... for Clubs and Organizations from West Coast and Mid America. Contact Seven Seas Travel, 17220 South Norwalk Blvd., Cerritos, Calif. 90701, Dawn Corrigan, 213/924-8383.

PC '77 Weekend admission at the door will be \$10.00. Register before August 10th SAVE 20% AVOID WAITING IN LINE! Admission includes exhibits and seminars for both days, August 27-28th.

Please rush _____ advance registration tickets for August 27-28th at \$8.00 each.

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The group fare is based on 40-person minimum. Should the group drop below that number, there would be an additional charge.

Exhibitors and visitors unable to utilize the group airfare due to varied flight dates may book the hotel package in order to take advantage of the group rate.

PLANNED ITINERARY

August 26

- | | |
|--|------------------------------|
| • TWA Flight 38 Lv. Los Angeles 9:00 a.m. | Arr. Philadelphia 4:50 p.m. |
| • United Flight 60 Lv. San Francisco 8:30 a.m. | Arr. Philadelphia 4:40 p.m. |
| • Bus Lv. Philadelphia 5:45 p.m. | Arr. Atlantic City 6:45 p.m. |

August 29

- | | |
|---|------------------------------|
| • Bus Lv. Atlantic City 3:45 p.m. | Arr. Philadelphia 4:45 p.m. |
| • TWA Flight 37 Lv. Philadelphia 6:00 p.m. | Arr. Los Angeles 8:15 p.m. |
| • United Flight 67 Lv. Philadelphia 5:45 p.m. | Arr. San Francisco 8:25 p.m. |

*Rates subject to tariff changes and minimum group 40 airfare.

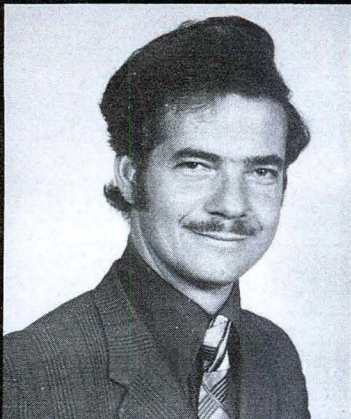
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*Add \$30 to package price

... FROM THE FOUNTAINHEAD

By Adam Osborne



For some time I have been predicting that the computer "hobby" market would develop into a professional computing market, wherein the hobbyist is in reality a part-time consultant and the computer store is the hardware supplier. We are on the verge of seeing the first widespread manifestation of this phenomenon.

A variety of microcomputer systems are being readied for sale as small business data processing computers. Every microcomputer system on the market today is being configured for data processing, providing it has the necessary peripherals: a CRT, floppy discs, and a printer. The universal programming language of these business systems is BASIC. But in the wings lurk three mass merchandisers whose combined efforts are going to turn this market on its head once again—as though that already has not happened often enough.

The Heath Company, whose microcomputer system entries we described last month, will emphasize data processing applications.

Radio Shack will be introducing their own Z80-based microcomputer system shortly; the entire emphasis of this system is on small business data processing.

Commodore is bringing the era of predatory price wars to small business systems with its recently-announced PET. For \$495.00 is offered a CRT, keyboard, cassette drive, 6502 CPU and memory, plus BASIC interpreter. PET will be sold with "canned" business programs.

The entry of Radio Shack, Commodore and the Heath Company into the ranks of small business system computer manufacturers must certainly lend a formidable new perspective to this entire marketplace.

The May 30 issue of "Business Week" carried a long article identifying the profound effect that IBM's entry into small computer systems would have on small business data processing. I believe the "Business Week" article largely missed the point. The entry of Radio Shack, Heath Company and Commodore into the same marketplace is going to have a far more profound effect on small business systems than the entry of IBM. IBM is not currently an important factor in this vast low-end market, nor do they understand the extreme price sensitivity of this market. Also, IBM has no history of participating in, nor of succeeding within predatory price wars. Some compatible peripheral manufacturers may take exception to this statement, but what IBM has indulged in

is simple defensive price cutting, not the type of price wars that leave blood spattered all over the marketplace and the bodies of dead corporations littering the scene.

Let us examine the current scenario.

Today you can buy a microprocessor-based CPU, a CRT, a pair of floppy discs and a printer for between \$10,000.00 and \$15,000.00. Based on the Commodore PET, however, you will be able to buy a CPU, CRT, keyboard, pair of cassette drives and an inexpensive strip printer for around \$2,000.00.

How low can these prices go?

A data processing CRT must have higher resolution than the standard home television screen, but when data processing sales volumes achieve consumer levels, chances are that CRTs will be priced at the high end of the black-and-white TV set range—perhaps \$200.00. A keyboard with interface logic, in large quantities, can achieve a price of perhaps \$50.00. A printer, in commercial quantities, need cost no more than an electric typewriter; add \$250.00. The CPU, with 16,000 bytes of memory will sell for \$200.00, or less, once the dust settles. Thus, the small business computer system will cost \$700.00 before adding bulk storage devices.

Cassette drives can be added for about the same cost as good-quality cassette recorders—let us say, \$50.00 each. When hundreds of thousands of floppy discs are sold a year, a pair of drives, with controller, will be available for \$500.

I expect that cassette-based business systems will be available for less than \$1,000.00 in two years. Within this same time frame, floppy-disc-based business systems will be available for perhaps \$2,000.00.

Of course, these entry-level systems have severe performance restrictions, but there are innumerable small companies who will be quite comfortable with these restrictions. For those who need more capability, it will be available for more money.

But what about programs?

Again at the entry level, very inexpensive programs will be available. We at Osborne & Associates, for example, are publishing as books business data processing programs generated over the last five years for WANG Laboratories Equipment. Individual books will cost \$12.50, which means that an entire data processing package may be purchased, together with all documentation, for \$50.00. We will not be alone in this book market. And, for the user who needs more than a book will provide,

there are the thousands of hobbyists who are rapidly gaining the proficiency to modify existing programs, or write new programs inexpensively.

But what of the future?

We would be deluding ourselves to think that microprocessor technology has reached any type of plateau. It is only three years since the 8080A appeared on the scene, yet we already have single chip NOVA minicomputer central processing units from Data General and Fairchild. Semiconductor manufacturers have been increasing the logic on single chips by a factor of ten every two years and I see no slowdown in this rate of progress. In fact, over the next year, I believe we will see some startling advances in chip fabrication technologies — which I will describe in next month's column. All this suggests that we are only at the beginning of LSI technology's ultimate capabilities; and the type of small, inexpensive system I have described will not remain small for long.

The price will remain constant, but the performance will rapidly escalate to compete with respectably-sized business computers of today.

And who is poised to take advantage of this coming explosion? The computer stores.

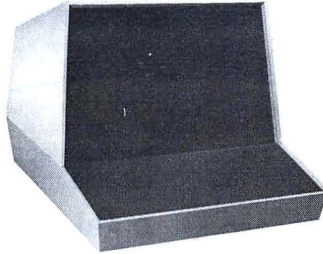
There is one computer store that disagrees sharply with my opinion that stores should stick to selling hardware while leaving programming to hobbyist and store customers. Pete Roberts, of Computer Kits on University Avenue in Berkeley, (415) 845-5300, sells entire systems. Store personnel write all programs and integrate the system. In fact, this store offers a one-year guarantee on complete systems, plus a service contract.

Tom Dilatush of Real Time Microsystems (714) 424-3781, works at the other end of the spectrum. He repairs and completes boards which do not work after being assembled by hobbyists. So, all you hobbyists who have boards that don't work, send them to Dr. Dilatush; he will make them well. I know that there are many other companies that provide the same service, but Tom is the only one who has called to tell me about it. My telephone number is (415) 548-2805.

Last month I told you what Heath Company would be announcing for their Heath Kits; I was almost right. They are indeed coming out with an 8080A and an LSI 11 microcomputer system but floppy discs will not be around for awhile and DEC's disc operating system software may or may not be available with Heath Kits.

The Perfect Cover-Up!!!

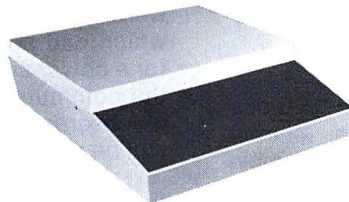
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Diablo

SELECTRIC VS. DIABLO HARDCOPY PRINTER

Until recently, there were very few hard copy devices with lower-case capability at prices that the hobbyist could afford. The cheapest of them were the DEC-WRITER II, the Model 38 Teletype, and the TI Silent 700. All of these had disadvantages in terms of print quality, and all were priced at over \$1750. Much has been written and said about converting an office Selectric typewriter to an output device by mounting the appropriate solenoids, but very few hobbyists have attempted this mechanically exacting task.

In recent months, however, the situation has changed with the appearance on the used market of complete terminals based on the IBM I/O Selectric, and of printers using the *Diablo* or *Qume* print mechanism. Both types seem to be available at \$800-\$1,000, both have lower case, 132-column line width and interchangeable type elements, and both give excellent print quality. Of the two, the *Diablo/Qume* equipment is far the better buy for the hobbyist, for a number of reasons which include ease of interfacing to 8080 and 6800-based microcomputers, speed and reliability.

SELECTRIC PRINTERS

Taking the Selectric units first, they run at 14.9 cps (max) and are nearly as noisy as a Teletype. Maintenance is a nightmare—the Selectric has over 600 moving parts and repairs to the mechanism call for some special tools, a high degree of mechanical sense, and familiarity with the way it works. Trouble-shooting the logic is a cross between psychotherapy and black magic. If you must buy a Selectric-based terminal, make sure that a service contract is available for at least the first year until you know what you are doing. In our terminal room, the three AJ Selectronic 841 terminals needed a service call about every three weeks for each terminal; most of these involved electro-mechanical problems that caused the unit to convert computer output to garbage. We had previously had six UCC 1035 units (currently being advertised by Rondure under the Carterfone label, with service contract). These just could not take being pounded eight hours per day by programmers, and service calls averaged one per three days per terminal. Selectric terminals are not simple to interface to an 8080 nor to 6800, because they use a code consisting of 6 data bits and odd parity, (EBCDIC for talking to IBM computers or Correspondence for talking to MTST or MagCard word processors). The characters are sent backwards from the microcomputer's point of view (i.e., Most Significant Bit first), and some line protocol is needed to switch them from send to receive and vice versa. The software driver must not only do ASCII/Selectric and Selectric/ASCII code conversion, including recognition of case changes and the insertion of shift codes into the output stream, but must also recognize the end-of-line string (Return followed by EOT) and send

back an appropriate response. If the terminal does not receive the response, the keyboard stays locked.

DIABLO PRINTERS

The *Diablo* and *Qume* printer mechanisms are very similar to each other. They operate on identical principles, but the *Qume* is the later development and is a little more rugged and a little faster (up to 55 cps, instead of the *Diablo's* 30 cps). Since, to my knowledge, only early *Diablo* printers have so far appeared on the used market, I shall confine my remarks to these. The *Diablo* mechanism is very much quieter than the *Selectric* and is inherently far more reliable—it has only about eight moving parts instead of the *Selectric's* 600+.

There were twelve terminals using the *Diablo* mechanism in the terminal room which I mentioned previously, and service calls averaged one per month over a period of a year—one unit needed three calls, but the other nine calls were for a different terminal each time. *None* of the calls involved the printer mechanism—six were for keyboard problems, two were for connectors which had not been screwed down and loosened, one for a power supply problem, and three for failed chips in the communications logic. The *Diablo* mechanism has much greater possibilities than the *Selectric*, since it can be programmed by *Diablo* to allow both forward and reverse platen and carriage movements under control of the host computer, and spacing can be programmed for 10-pitch (Pica) or 12-pitch (Elite) type, or for proportional spacing to give true justification of text.

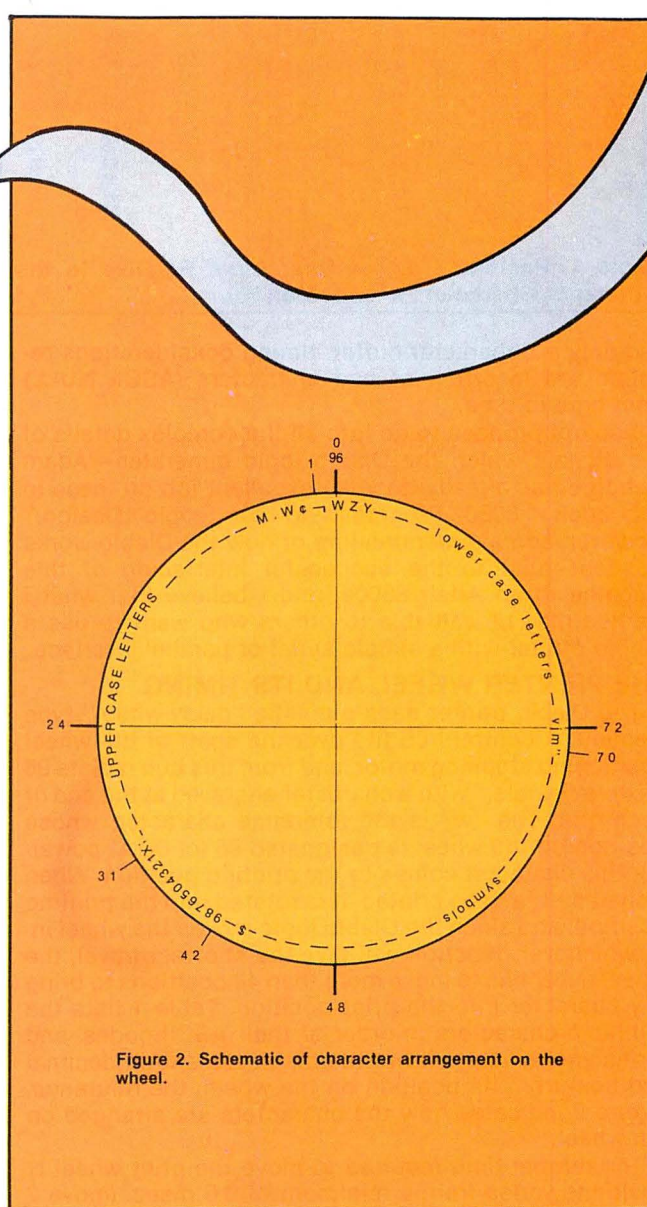
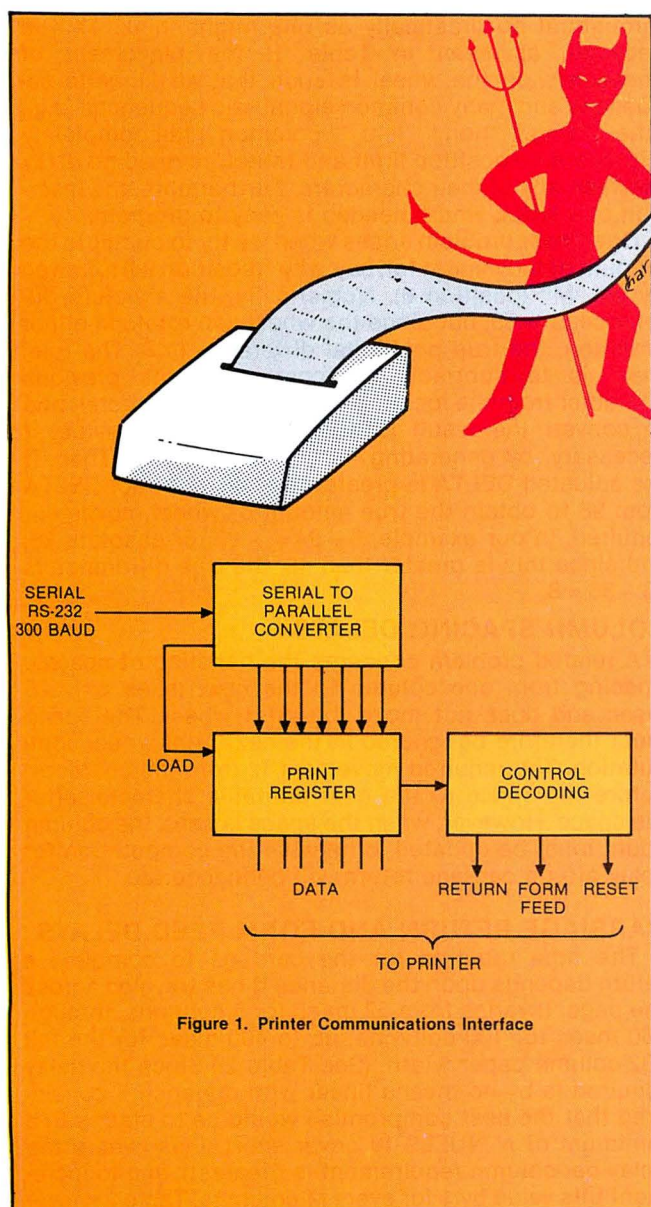
Graphics enthusiasts react with pleasure when they see a unit with all these options performing as a plotter under control from standard CAL-COMP plotter software. Best of all, from the hobbyist's viewpoint, the *Diablo* printer accepts standard 7-level ASCII code. However, when an OEM incorporates a *Diablo* mechanism into his own terminal or printer unit, the mechanism is supplied with all the logic to implement the selected options; the OEM supplies the communications interface and decoding logic to initiate the options. Thus, the units that come on the used market may vary considerably in their capability and requirements.

INTERFACING A DIABLO TO AN 8080 MICROCOMPUTER

I was recently fortunate enough to be lent the engineering prototype of a *Diablo* printer unit with a very simple-minded, 300-baud serial communications interface (see Figure 1). The unit was originally designed for an off-line printing application in which it would be driven by a 16-bit minicomputer with plenty of core and CPU time available during printing. Cheapness, not sophistication, was the watchword. The unit would recognize Printer Reset and Form Feed, and CR and LF would both cause a carriage-return line-feed. All other formatting was to be done in software. Since the unit

OUTPUT DRIVER ROUTINE — DODR

(Try a Diablo — You'll Like it!)



CHARACTER HEX	SYM	DISPLACEMENT DEC	HEX	CHARACTER HEX	SYM	DISPLACEMENT DEC	HEX
21	!	68	44	50	P	26	1A
22	"	70	46	51	Q	27	1B
23	#	46	2E	52	R	13	0D
24	\$	44	2C	53	S	14	0E
25	%	47	2F	54	T	16	10
26	&	69	45	55	U	23	17
27	'	54	36	56	V	30	1E
28	(	60	3C	57	W	04	04
29	)	58	3A	58	X	32	20
2A	*	61	3D	59	Y	25	19
2B	+	45	2D	5A	Z	07	07
2C	,	03	03	5B	[	53	35
2D	-	43	2B	5C	\	63	3F
2E	.	05	05	5D	]	51	33
2F	/	66	42	5E	^	64	40
				5F	_	55	37
30	0	37	25				
31	1	33	21	60	€	02	02
32	2	34	22	61	a	84	54
33	3	35	23	62	b	78	4E
34	4	36	24	63	c	79	4F
35	5	38	26	64	d	76	4C
36	6	39	27	65	e	83	53
37	7	40	28	66	f	89	59
38	8	41	29	67	g	74	4A
39	9	42	2A	68	h	87	57
3A	:	12	0C	69	i	85	55
3B	;	31	1F	6A	j	72	48
3C	<	57	39	6B	k	93	5D
3D	=	48	30	6C	l	77	4D
3E	>	50	32	6D	m	71	47
3F	?	65	41	6E	n	82	52
				6F	o	80	50
40	@	62	3E				
41	A	11	0B	70	p	90	5A
42	B	08	08	71	q	92	5C
43	C	10	0A	72	r	81	51
44	D	22	16	73	s	88	58
45	E	15	0F	74	t	86	56
46	F	09	09	75	u	91	5B
47	G	24	18	76	v	73	49
48	H	17	11	77	w	96	60
49	I	20	14	78	x	75	4B
4A	J	29	1D	79	y	94	5E
4B	K	28	1C	7A	z	95	5F
4C	L	21	15	7B	{	49	31
4D	M	06	06	7C	:	59	3B
4E	N	19	13	7D	}	67	43
4F	O	18	12	7E	~	52	34

Table 1. Position ("d") of Characters Relative to the Reference Character "w" (position 96).

had only a 2-character buffer, timing considerations required the insertion of pad characters (ASCII NULL) from time to time.

I do not propose to go into all the complex details of the signals which the Diablo logic generates—Adam Osborne has already done an excellent job on these in his book "8080 Programming for Logic Design." However, some understanding of how the Diablo works was essential to the successful interfacing of this machine to an Altair 8800a, and I believe that what I learned may be valuable to others who want to use a Diablo printer with a simple serial or parallel interface.

THE PRINTER WHEEL AND ITS TIMING

The Diablo printer uses a plastic "daisy-wheel" type element. A central hub fits over the shaft of the wheel positioning stepping motor, and from this hub radiate 96 flexible "petals," with a character engraved at the end of each one. The "w" is the reference character, whose position on the wheel is designated 96 (or 0). At power-up, this character comes to the printing position. When a character is to be printed, it is rotated into the printing position, and since the Diablo logic moves the wheel into whichever direction will give the shortest travel, the wheel never has to move more than 48 positions to bring any character into the print position. Table 1 lists the printable characters in order of their ASCII codes, and for each character shows the displacement (in decimal and hex) from its position on the wheel, the reference. Figure 2 indicates how the characters are arranged on the wheel.

The normal time required to move the print wheel N positions varies from a minimum of 9.5 msec. (move 2 positions), through 23.5 msec. (move 10 positions), to a maximum of 51 msec. (move 48 positions). To each of these times must be added some fixed settling times totaling 7 msec. It is clear that for wheel movements of

up to 10 positions ($23.5 + 7.0 = 30.5$ msec.), the printing time is less than the time required to transmit one character (33.33 msec.), and therefore no additional delay is required between characters.

For larger wheel movements, we must transmit the character and then delay the next printable character by up to $(51 + 7) - 33.33 = 24.67$ msec. There are two ways of implementing such a delay. The most precise would be to compute the number of positions to be moved and use this number as the address in a lookup table; the entry in the table would be a number which, when loaded into a delay counter register, would give the required delay. This method would give the best throughput, at the cost of increasing the complexity of the driver software.

The method recommended by the vendor of my machine is merely to transmit an ASCII NULL after every character which has required a wheel movement of more than 10 positions. The NULL, when it reaches the print register, does not disturb a printing operation already in progress. Although this method does indeed introduce more delay than is needed ($66.66 - 58 = 8.66$ msec for a 48-position move, and $66.66 - 36.5 = 30.16$ msec for a 16-position move), it does not reduce throughput so drastically as one might think. This is because, as seen in Table 1, the placement of characters on the wheel is such that all numeric sequences and many common alphabetic sequences (e.g., "the," "ting," "tion," "ical," "common") fall completely within the 10-position limit and therefore need no delay between any of their characters. Furthermore, the insertion of a NULL where needed is easy to program.

One minor problem arises when we try to compute the amount of movement for, say, a "y" (position 94) followed by an "M" (position 6). Numerically, the absolute difference is -88 , but since the wheel can rotate in either direction, the true positional difference is 8. The rule, then, is to subtract the location of the previous character from the location of the current character, and to convert the result (DELTA) to a positive value, if necessary, by generating its 2's complement. Then, if the adjusted DELTA is greater than 48, subtract DELTA from 96 to obtain the true amount of wheel movement required. In our example, $6 - 94 = -88$, or absolute 88, and since this is greater than 48, the true difference is $96 - 88 = 8$.

COLUMN SPACING DELAYS

A related problem concerns the handling of spaces. Spacing from one column to the next takes only 25 msec and does not move the print wheel. The space must therefore be ignored in the next print wheel computation. The required movement is from the character before the space to the next printable character after the space. However, when the space is sent, the column count must be updated, otherwise the computation for delay after a carriage return will be inaccurate.

CARRIAGE RETURN AND FORM FEED DELAYS

The time required for the carriage to complete a return depends upon the distance it has traveled across the page. It varies from 52 msec for 5 columns, through 260 msec for 100 columns, up to 400 msec for the full 132-column paper width. (See Table 2.) Since the delay required is by no means linear with distance, I considered that the best compromise would be to start with a minimum of N NULLS to cover short lines (where the delay-per-column requirement is greatest), and to increment this value by 1 for every M columns. Table 2 shows that a minimum of three NULLS, incremented by 1 for every 15 columns, gives adequate delay for all lines up to 110 columns. The delay for 132 columns would be 9% short, but in my particular application full width lines

are never found. The routine to perform this computation is quite straightforward.

After a form feed, there must be a delay of 92 msec for each line skipped. This is approximated by sending three NULLS for each skipped line; the count is somewhat too high for a 60-line feed ($60 \times 99.9 = 5994$ msec, vs. $60 \times 92 = 5520$ msec), but I find that the average skip is six to twelve lines, and here the extra delay is not noticed.

A COMPLETE DRIVER SOFTWARE ROUTINE

With the software timing requirements of the printer itself resolved, we can now specify the characteristics desired in the driver routine. For my system, which uses a CRT terminal as the console, with list output assignable either to the CRT or to the printer, with a MITS 88-2SIO dual serial RS-232 interface board, the goals were as follows:

1. The driver should be a generalized console/list output module with one entry point and one exit. Register pairs HL, DE, BC should be saved on entry and restored on exit. The single-entry goal could not be realized, because the hex monitor (TDL APPLE, Version 2.6) passes the characters in C, the octal monitor passes characters in A, and the IM-SAI Editor/Assembler package passes characters in B. Thus, three separate entry points had to be provided, but all exits are made via the common end-routine (FIN) which restores the register pairs and executes the return.
2. The routine should include an echo to the CRT terminal at all times. This is not strictly necessary, but is convenient since the printer is separated from the terminal and Altair™ computer, and I would not otherwise see what I was typing on the keyboard. Also, to allow the CRT to run at 1200 baud when not printing, a sense switch should ENABLE/DISABLE the printer part of the routine. Since the Assembler uses SW15 to stop listing, SW14 was chosen as the PRINT ENABLE switch.
3. Since all the programs using the routine call a CR/LF routine to start a new line, another sense switch (SW13) should give the option of rejecting/accepting the LF character to give single/double spacing of printed output.
4. To allow initialization, a PRINTER RESET character issued either by the keyboard or by a calling program should be passed on to the printer, and should also zero the line count. If the paper is manually set to line 4 of a new page after the reset, all subsequent printout text will be divided into pages of 60 lines with three blank lines at top and bottom.
5. When a FORM FEED character is issued either by the calling program to terminate a short page, or by the *carriage return* routine after 60 lines have been printed, the FORM routine should transmit the FF, save the current line count, reset the soft-

ware counter to zero, and use the saved count to compute three NULLS for each line skipped.

6. When a CR character is issued by the calling program or the keyboard, the CAR routine should send the character, save the current column count, zero the counter, and use the saved count to compute the delay required for the return to complete. It should also increment the line counter and test the incremented value; if this is greater than 59 (60 lines printed), CAR should put a form feed character in C and jump to the FORM routine to start a new page.
7. When a space character is sent, it should update the column count.
8. Control characters other than RESET, FF, CR, and LF should be ignored.
9. If the character is printable, the CALC routine should compute the wheel movement required. If this is more than 10 positions, set the NULL flag. Then send the character, update the column count, and test the NULL flag; if this is set, send a NULL, else exit to the end routine.

The manner in which these characteristics were implemented is shown in the flow charts and the commented listing. Note that the wheel position table, containing 96 entries, consists of the hexadecimal values given in Table 2, in the order shown. In the original print-out, the table starts on a page boundary in this listing. It could be moved up the page, but cannot cross a page boundary unless the pointer setting instructions in CALC are changed to allow this.

DIABLO PROGRAM

```

1800      *CONSOLE OUTPUT ROUTINE TO DRIVE TVT-II AND (IF ADDR
1800      *SW IS UP) A DIABLO PRINTER WITH 388-BAUD SERIAL
1800      *INTERFACE AND 2-CHARACTER BUFFER. CR & LF BOTH CAUSE
1800      *THE PRINTER TO DO CR/LF; IF SW13 IS DOWN, LF IS IGNORED;
1800      *IF UP, LF IS ACCEPTED FOR DOUBLE SPACING OF LINES.
1800      *COA ACCEPTS A CHARACTER PASSED IN A
1800      *COC ACCEPTS A CHARACTER PASSED IN C (APPLE, MINIMONITOR)
1800      *APPLICATIONS PROGRAMS MAY USE ANY OF THESE ENTRY POINTS.
1800      *ECHO SENDS CHARACTER TO TVT; PRINTING INHIBITED IF
1800      *SW 14 IS DOWN.
1800      *LOOK RECOGNIZES PRINTABLE & LEGAL CTRL CHARS
1800      *AND JUMPS TO PROPER ROUTINE.
1800      *CPI BAH *LF
1800      *CPI BAH *FORM FEED
1800      *CPI BAH *CR
1800      *CPI BAH *SP
1800      *CPI BAH *PROCESS SP
1800      *CPI BAH *IGNORE ILLEGAL CTRL CHAR
1800      *IF PRINTABLE, CHECK WHETHER IT MUST BE FOLLOWED BY NULL.
1800      *CALC LXI H, WHEEL
1800      *MOV B, M *SAVE DISP OF LAST CHAR
1800      *LXI H, PTAB
1800      *SUI 21H
1800      *ADD L
1800      *MOV L, A *POINT TO DISP FOR THIS CHAR
1800      *MOV A, M *GET DISP
1800      *STA WHEEL *AND SAVE IT IN WHEEL
1800      *SUB B *SUBTRACT OLD DISP
1800      *JP CALC3 *DELTA POSITIVE, GO COMPARE TO 48
1800      *CMA *DELTA NEGATIVE, SO MAKE IT
1800      *INR A *POSITIVE (2'S COMPLEMENT)
1800      *COMPARE DELTA TO 48 (MAX WHEEL MOV'T.) IF DELTA>48, THEN
1800      *SUBTRACT IT FROM 96 TO GET DELTA FOR SHORTEST MOV'T.
1800      *CALC3 CPI 30H
1800      *JC CALC4 *DELTA<48
1800      *JZ NULL *DELTA=48
1800      *CMA *DELTA>48, SO
1800      *INR A *SUBTRACT IT
1800      *FROM 96
1800      *CALC4 CPI 0AH *COMPARE ADJUSTED DELTA TO 18
1800      *JC COLS *DELTA<18, NO NULL NEEDED
1800      *NULL MVI D, 0FFH *SET NULL FLAG
1800      *COLS LXI H, HEAD
1800      *INR M *UPDATE COLUMN COUNT
1800      *CALL PRT *SEND CHAR.
1800      *MOV A, D *GET NULL FLAG
1800      *ORA A
1800      *JZ FIN *FLAG NOT SET, DONE
1800      *MVI C, 0 *FLAG SET, PUT NULL IN C
1800      *CALL PRT *AND SEND IT
1800      *FIN
1800      *COMMON END ROUTINE: RESTORE REGS & RETURN TO CALLER.
1800      *FIN POP B
1800      *POP D
1800      *POP H
1800      *RET

```

IDEAL	DELAY	ACTUAL	DELAY
COLS	MS	NULLS	MS
5	52	3	99.9
10	72	3	99.9
20	108	4	133.3
30	126	4	133.3
40	145	5	166.5
50	168	5	166.5
60		6	199.9
80		7	233.3
100	260	8	266.6
120		9	299.9
132	400	10	333.3

Table 2. C/R Delays

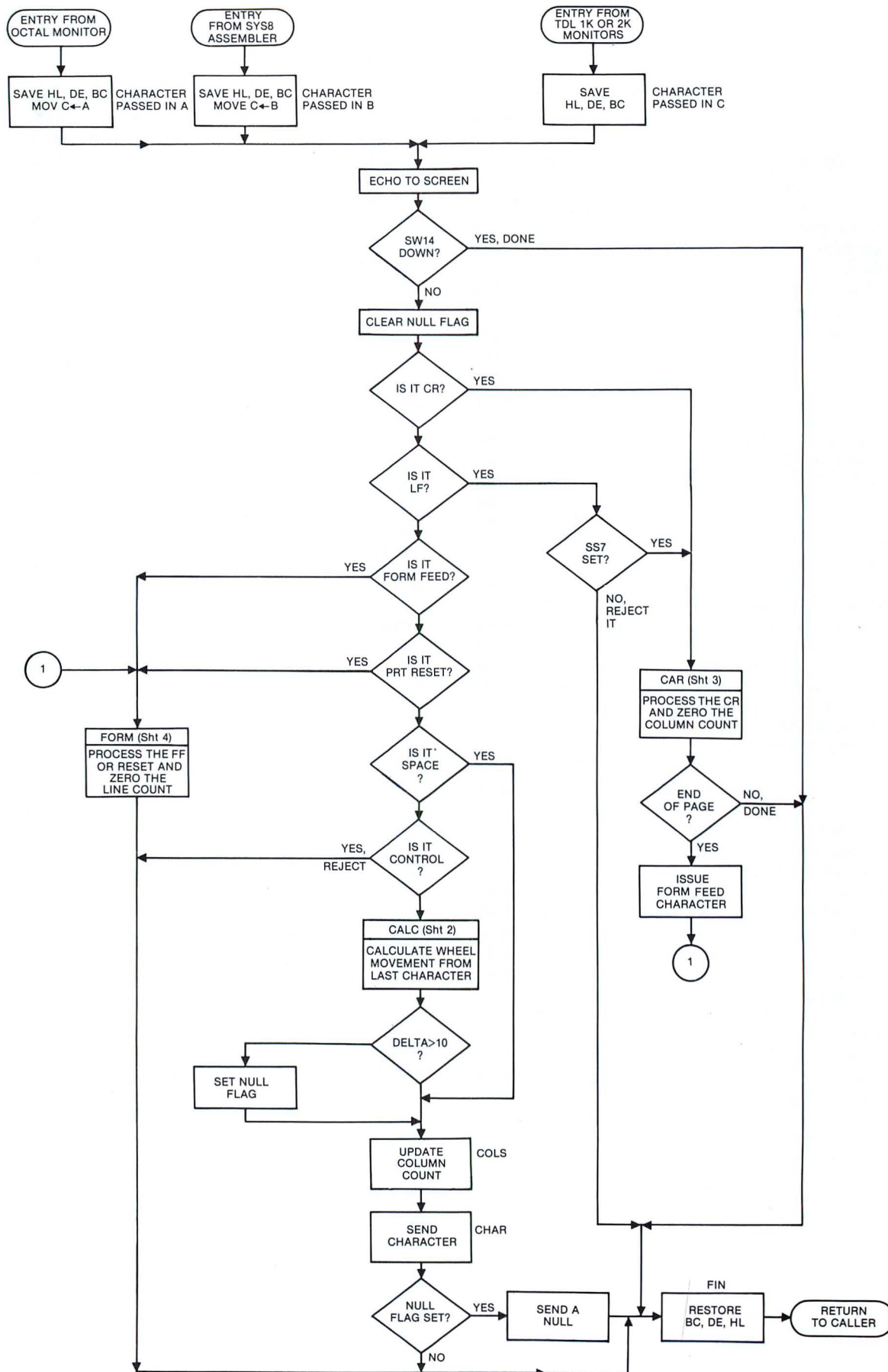


Figure 3. Driver - Overall Flow Chart


```

0715 *
0720 *CHECK SPACING, PROCESS CW,UPDATE LINE COUNT
0730 *IF SW13 UP, PROCESS LF AS A CR.
0740 *TWOP IN 20TH *READ SSW
0750 *ANI 20H *TEST SW13
0760 *JZ FIN *DOWN; IGNORE LF, DONE.
0770 CAR CALL PRNT *SEND THE LF OR CR
0780 LVI H,HEAD
0790 *MOV R,M *GET COLUMN COUNT
0800 *LVI R,03FH *SET MIN NULS=3 & DIVISOR=15
0810 *INCREMENT NULL COUNT (R) FOR EVERY 15 COLUMNS
0820 CAR SUB
0830 *JM CAR2 *NULLS COMPUTED
0840 INP R
0850 *JM CAR1
0860 CAR2 XSI A
0870 *MOV M,C *ZERO THE COLUMN COUNTER (HEAD)
0880 *MOV C,0 *NULL TO C
0890 CAR3 CALL PRNT *SEND COMPUTED NO. OF NULS
0900 DCH
0910 *JL CAR3
0920 *UPDATE LINE CNT; IF56H, NO FORM FEED
0930 LCNT LXI H,LINES
0940 INP M *UPDATE LINE COUNT
0950 *MOV M,M
0960 CPI 3CH *LINES?59?
0970 JC FIN *NO, DONE
0980 *MOV B,C,CH *YES, PUT FORM FEED IN C
0990 *
1000 *PROCESS FORM FEED AND ZERO LINE COUNT
1010 FORM CALL PRNT *SEND THE LF
1020 LXI H,LINES
1030 *MOV B,M *SAVE COUNT
1040 XPA A
1050 * *
1060 *A *STORE 0 IN LINES
1070 *A,42H *SET A TO PAGE FEED (66 LINES)
1080 SUB *SUBTRACT LINES PRINTED
1090

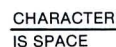
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```

1080      MOV P,A      *SAVE DELTA
1090      RLC          *A=2.DELTA
1100      ADD B        *A=3.DELTA
1110      MOV B,A      *SAVE AS COUNT
1120      MVI C,4      *NULL TO C
1130 FORM2 CALL PRT    *SEND 3 NULLS PER LINE MOVED
1140      DCR B
1150      JNZ FORM2
1155      JMP FIN      *DONE
1160 *
1170 *PRINT SURROUTINE
1180 PRT 1N 2H
1190      ANI 2H
1200      JZ PRT
1210      MOV A,C
1220      OUT 3H
1230      RET
1240 *
1250 WHEEL DR 00
1260 HEAD DR 00
1270 LINES DR 00
1280 *THE DISPLACEMENT TABLE MUST NOT CROSS A PAGE BOUNDARY
1285      ORG 3100H
1290 STAR

```

COA	3020	COB	3027	COC	302E	ECHO	3031
LOOK	3043	CALC	3061	CALC2	3065	CALC3	3076
CALC4	3082	NULL	3087	COLS	3089	CHAR	30BD
FIN	309A	TWOSP	309E	CAR	30A5	CAR1	30AC
CAR2	30B7	CAR3	30BB	LCNT	30C2	FORM	30CF
FORM2	30E0	PRT	30EA	WHEEL	30F5	HEAD	30FF
LINES	30F7	PTAB	310A				



EXIT
TO FIN

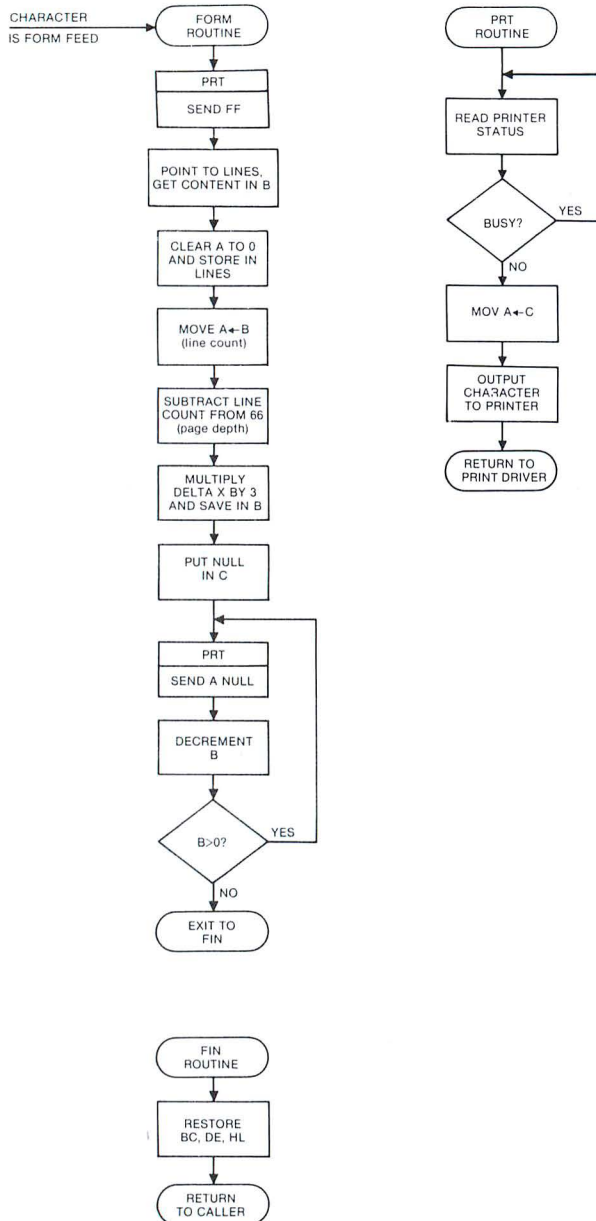


Figure 6. Form Feed Processing, End Routine, and PRT Subroutine.

Figure 5. Form Feed Processing, End Routine, and PRT Subroutine.

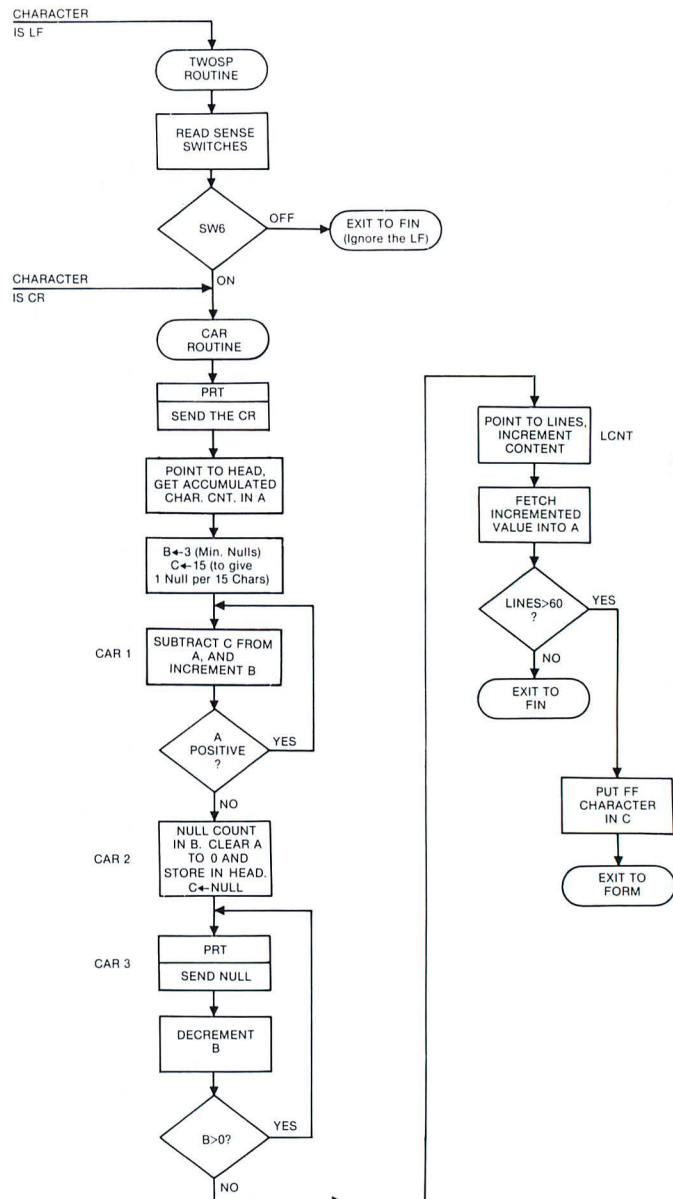


Figure 6. Form Feed Processing, End Routine and PRT Subroutine.

Figure 5. Form Feed Processing, End routine, and PRT Subroutine.

EVALUATING AN EVALUATOR

A Report on Motorola's MEK6800D2 Evaluation Kit

by William Sevedge, Coordinating Editor

Motorola's Integrated Circuit Division recently unveiled a microcomputer evaluation kit for M6800 systems. Designated as the MEK6800D2 Evaluation Kit, it contains a microcomputer module and a keyboard/display module which contains circuitry for an audio cassette interface. The display consists of six 7-segment LED readouts that show address and data in hexadecimal format. The hexadecimal keyboard along with eight additional command keys, permits ease of programming.

GENERAL DESCRIPTION

A standard MEK6800D2 kit is designed to provide a completely self-contained method for evaluating the characteristics of the M6800 family. Besides the M6800 MPU the kit contains one MCM6830 ROM with Jbug monitor program, three MCM6810 RAM (128x8) memory, two MC6820 peripheral interface adapters (PIA), one MC6850 asynchronous communications interface adapter (ACIA), and one MC6871B 614.4KHz clock generator. The microcomputer module printed circuit board is pre-engineered to accept the following additional components for expanding its capability. Two MCM6810 RAM (128x8) memory, two MCM68708 EPROM (equivalent to 2708), three MC8T97 buffers, and two MC8T26 bi-directional buffers. This expansion capability provides for a variety of user operating modes. Included in the MEK6800D2 kit is the M6800 Microcomputer System Design Data book, M6800 Programming Reference Manual, and the construction/check-out manual. An excellent addition would be to purchase the M6800 Microprocessor Applications Manual. A complete MEK6800D2 is shown in Photos 1 and 1a.

CAPABILITY

The integral keyboard/display module can be used in conjunction with the Jbug monitor program for entering and debugging user programs. Programs may also be loaded and dumped via the audio cassette interface. The keyboard, display, and audio cassette interface are on a separate module apart from the microcomputer module so that ACIA and second PIA are available if the user has access to an RS-232 or TTY terminal. Wire wrap spaces for up to twenty 16-pin dual-in-line packages are available for user-designed circuitry on the microcomputer module. The MEK6800D2 is designed to accept, in place of Jbug, Motorola's MINIBug III monitor program. MINIBug III has monitored and diagnostic capabilities similar to Jbug, but intended for use with RS-232 and TTY type terminals.

The MEK6800D2 also permits several different memory configurations. The two MCM6810 (128x8) RAMs provided with the standard kit will accommodate programs up to 256 bytes. The third MCM6810 RAM is reserved for the use of the Jbug monitor program. The addition of two optional MCM6810 RAMS will increase the capability to 512 bytes. Strapping options for the additional ROM sockets permit any of the following combinations:

- 1024 bytes in 512x8-bit PROMs (Harris 7641)
- 2048 bytes in 1024x8-bit EPROMs (MCM68708)
- 2048 bytes in 1024x8-bit Mask-Programmable ROMs (MCM68308)
- 4096 bytes in 2048x8-bit Mask-Programmable EPROMs (MCM68316)

Depending on the type of programs loaded into ROMs, PROMs, and EPROMs may require that they be first put into RAM to be effective. This means sufficient RAM over 512

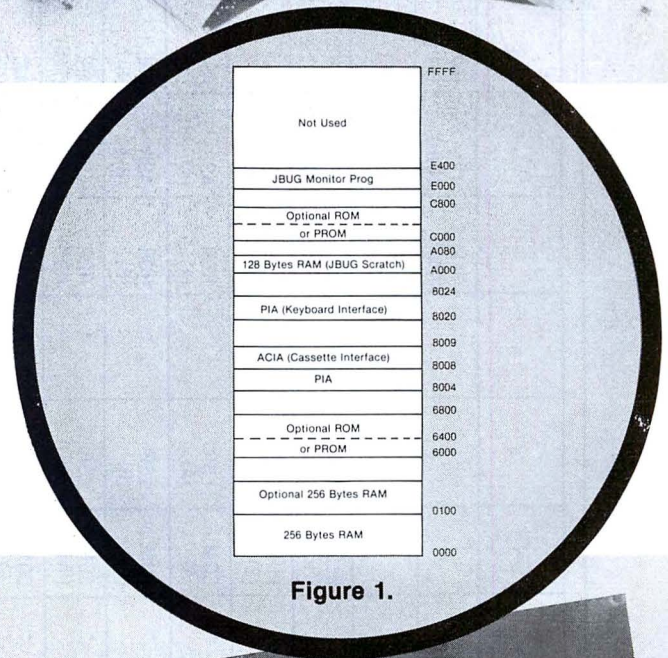
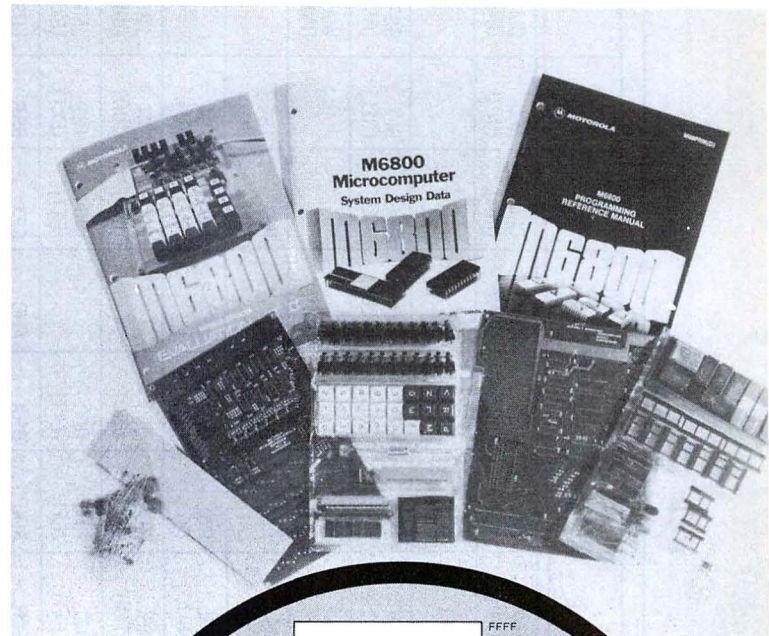
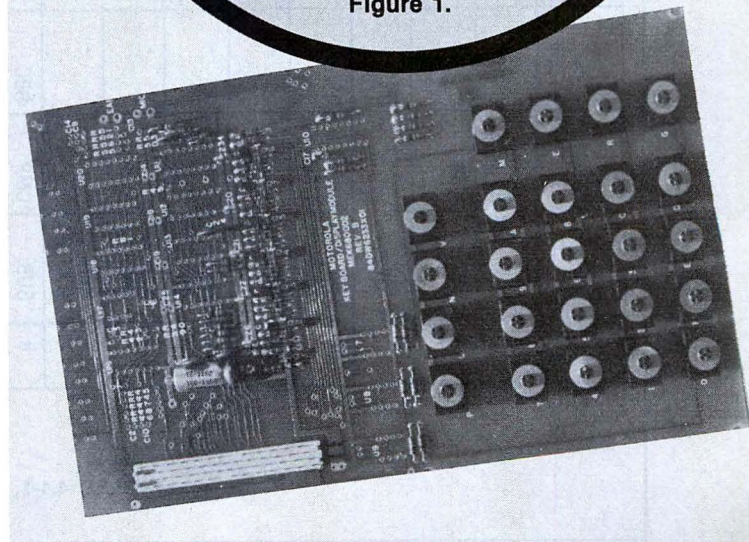


Figure 1.



LSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
MSB																
0	NOP (INH)	*	*	*	*	*	TAP (INH)	TPA (INH)	INX (INH)	DEX (INH)	CLV (INH)	SEV (INH)	CLC (INH)	SEC (INH)	CLI (INH)	SEI (INH)
1	SBA	CBA	*	*	*	*	TAB (INH)	TBA (INH)	*	DAA (INH)	*	ABA (INH)	*	*	*	*
2	BRA (REL)	*	BHI (REL)	BLS (REL)	BCC (REL)	BCS (REL)	BNE (REL)	BEQ (REL)	BVC (REL)	BVS (REL)	BPL (REL)	BMI (REL)	BGE (REL)	BLT (REL)	BGT (REL)	BLE (REL)
3	TSX (INH)	INS (INH)	PUL (A)	PUL (B)	DES (INH)	TXS (INH)	PSH (A)	PSH (B)	*	RTS (INH)	*	RTI (INH)	*	*	WAI (INH)	SWI (INH)
4	NEG (A)	*	*	COM (A)	LSR (A)	*	ROR (A)	ASR (A)	ASL (A)	ROL (A)	DEC (A)	*	INC (A)	TST (A)	*	CLR (A)
5	NEG (B)	*	*	COM (B)	LSR (B)	*	ROR (B)	ASR (B)	ASL (B)	ROL (B)	DEC (B)	*	INC (B)	TST (B)	*	CLR (B)
6	NEG (IND)	*	*	COM (IND)	LSR (IND)	*	ROR (IND)	ASR (IND)	ASL (IND)	ROL (IND)	DEC (IND)	*	INC (IND)	TST (IND)	JMP (IND)	CLR (IND)
7	NEG (EXT)	*	*	COM (EXT)	LSR (EXT)	*	ROR (EXT)	ASR (EXT)	ASL (EXT)	ROL (EXT)	DEC (EXT)	*	INC (EXT)	TST (EXT)	JMP (EXT)	CLR (EXT)
8	SUB (A) (IMM)	CMP (A) (IMM)	SBC (A) (IMM)	*	AND (A) (IMM)	BIT (A) (IMM)	LDA (A) (IMM)	*	EOR (A) (IMM)	ADC (A) (IMM)	ORA (A) (IMM)	ADD (A) (IMM)	CPX (A) (IMM)	BSR (REL)	LDS (IMM)	*
9	SUB (A) (DIR)	CMP (A) (DIR)	SBC (A) (DIR)	*	AND (A) (DIR)	BIT (A) (DIR)	LDA (A) (DIR)	STA (A) (DIR)	EOR (A) (DIR)	ADC (A) (DIR)	ORA (A) (DIR)	ADD (A) (DIR)	CPX (A) (DIR)	*	LDS (DIR)	STS (DIR)
A	SUB (A) (IND)	CMP (A) (IND)	SBC (A) (IND)	*	AND (A) (IND)	BIT (A) (IND)	LDA (A) (IND)	STA (A) (IND)	EOR (A) (IND)	ADC (A) (IND)	ORA (A) (IND)	ADD (A) (IND)	CPX (A) (IND)	JSR (IND)	LDS (IND)	STS (IND)
B	SUB (A) (EXT)	CMP (A) (EXT)	SBC (A) (EXT)	*	AND (A) (EXT)	BIT (A) (EXT)	LDA (A) (EXT)	STA (A) (EXT)	EOR (A) (EXT)	ADC (A) (EXT)	ORA (A) (EXT)	ADD (A) (EXT)	CPX (A) (EXT)	JSR (EXT)	LDS (EXT)	STS (EXT)
C	SUB (B) (IMM)	CMP (B) (IMM)	SBC (B) (IMM)	*	AND (B) (IMM)	BIT (B) (IMM)	LDA (B) (IMM)	*	EOR (B) (IMM)	ADC (B) (IMM)	ORA (B) (IMM)	ADD (B) (IMM)	*	*	LDS (IMM)	*
D	SUB (B) (DIR)	CMP (B) (DIR)	SBC (B) (DIR)	*	AND (B) (DIR)	BIT (B) (DIR)	LDA (B) (DIR)	STA (B) (DIR)	EOR (B) (DIR)	ADC (B) (DIR)	ORA (B) (DIR)	ADD (B) (DIR)	*	*	LDS (DIR)	STS (DIR)
E	SUB (B) (IND)	CMP (B) (IND)	SBC (B) (IND)	*	AND (B) (IND)	BIT (B) (IND)	LDA (B) (IND)	STA (B) (IND)	EOR (B) (IND)	ADC (B) (IND)	ORA (B) (IND)	ADD (B) (IND)	*	*	LDS (IND)	STS (IND)
F	SUB (B) (EXT)	CMP (B) (EXT)	SBC (B) (EXT)	*	AND (B) (EXT)	BIT (B) (EXT)	LDA (B) (EXT)	STA (B) (EXT)	EOR (B) (EXT)	ADC (B) (EXT)	ORA (B) (EXT)	ADD (B) (EXT)	*	*	LDS (EXT)	STS (EXT)

DIR = Direct Addressing Mode
 EXT = Extended Addressing Mode
 IMM = Immediate Addressing Mode
 IND = Index Addressing Mode
 INH = Inherent Addressing Mode
 REL = Relative Addressing Mode
 A = Accumulator A
 B = Accumulator B
 * = Unimplemented Op Code

TABLE 1-4.1-1. M6800 Instruction Map

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bytes must be externally available if these options are used. A general memory organization (memory map) is shown in Figure 2.

The MEK6800D2 can be upgraded to EXCORcisor compatible status by adding the optional buffers in the spaces provided; therefore, all the EXCORcisor I/O (input/output) and memory modules can also be used with this kit. By adding MINIBug III, an 8K memory board, and the EXCORcisor Resident/Assembler to the microcomputer module, the MEK6800D2 Evaluation kit graduates to a complete development/prototyping tool.

EVALUATION OF THE MEK6800D2 CONSTRUCTION DATA

The text of the MEK6800D2 as with most microcomputer evaluation kits, is definitely not designed for the novice computer hobbyist. The construction details include: a parts list, component layout, and schematic diagram. There is a section on construction hints which involves the construction of the ribbon cable assembly up to 80%. The table on MOS handling recommendations is excellent if not excessive, but should be followed closely to avoid static damage to these sensitive components. Unlike commercial kits other than computers, where step-by-step planning is given to assure the product is assembled properly, care is needed during assembly of the MEK6800D2 Evaluation Kit. Sockets are provided for the M6800 MPU, MCM6830 ROM, MCM6810 RAMs, MC6820 PIA, MC6850 ACIA, and MC6871B Clock Generator. Four additional sockets are provided for two additional RAM and ROM devices.

Although all the press photographs, and advertisements show that all the integrated circuits are in DIP (dual-in-line) sockets, in reality, this kit is not supplied with sockets for any of the 8-, 14-, 16-pin devices. This was somewhat disappointing when the inventory of the kit was concluded. Sockets were purchased locally to install onto this kit. The main reason sockets were used is for ease of maintenance

and troubleshooting. Removing a DIP integrated circuit device which has been soldered into the board is very difficult and will often result in lifted circuitry and damage to the component.

There is one modification to be incorporated into the printed circuit board which involves cutting two traces and adding several jumper wires. The instructions are clear, but care is required to assure the correct circuitry is cut. The purpose of this modification is to eliminate noise when loading or dumping from the cassette. As mentioned earlier, the construction hints gave step-by-step instructions for fabricating the ribbon cable assembly. Although elaborately written, the process did not work efficiently. The procedure calls out to use a bench vise to press together the edge connector (PT #3415-0001) and its cover (PT #3415) after proper alignment. The problem here is because the edge connector has guide posts on either side of the connector for alignment of the cover. These posts prevent the vise from fully seating the ribbon cable onto its respective pins. The other end of the cable which the connector is soldered onto the PCB is also supposed to be pressed using the bench. Possible damage to the PCB is likely if caution is not used at this point.

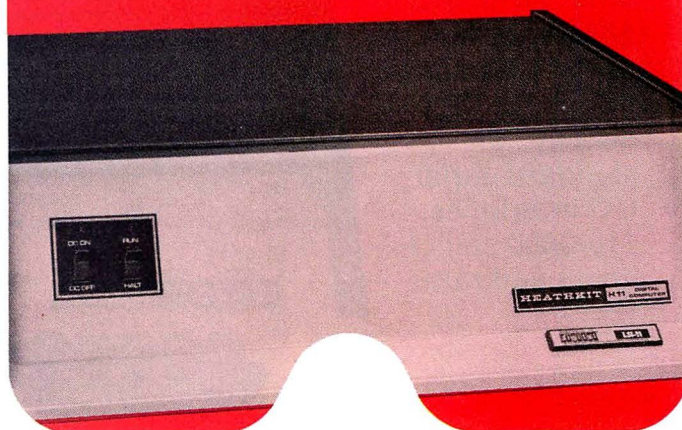
During construction of this kit, directions were followed to the letter, which caused the list of problems noted in the check-out section of this article. To help alleviate the problem of constructing the ribbon cable assembly, use a block of wood which will fit between the guide posts of the connector and another piece of wood against the backplane of the PCB. The wood will absorb the stress of clamping and prevent damage to the soldered connections of the connector. *The wood block against the PCB was the only variance of the procedure.*

CHECK-OUT AND TROUBLESHOOTING

When power was first applied to the MEK6800D2 Evaluation Kit, the display was not what was expected. When the reset button is depressed, a dash is expected to be

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displayed in the left-most display indicator of the four address displays, while all others are to be blanked. What appeared was a dash in each of the four address displays and a dash in each of the data displays. Since soldering and parts placement were verified prior to applying power, troubleshooting the problem was imminent. Power was checked on each module for voltage and current limiting. The keyboard had no effect and the clock was operating. With these symptoms the problem either had to be a bad component or an open line. The problem was found to be in the ribbon cable assembly. Both sides had *opens* on the data and address lines. A modification to the procedure was made during the re-fabrication of the cable assembly. The kit was now functioning and check-out was resumed.

The operating example in the construction manual was used to check out the unit. All the functions seemed to be operating properly, so the sample program was loaded, and when verified, found that addresses H20 and H22 were not correct. After several attempts to correct memory data, RAM was swapped into new locations. This had no effect, so back to the cable assembly. Although all pins had continuity, there were several pins with high resistance. The problem was on the connector at the keyboard/display module. The cover on the connector begins to bow in the center, because the insulation begins to contract, forcing the pins out of the ribbon cable. The sample program in the construction manual turned out to be an excellent piece of software, for it is written with an error incorporated in it. The detailed steps of the text allows the user to operate each of the control keys involved to help debug the program.

OPERATION

With relatively little usable memory (256 bytes) with which to work, operation of the MEK6800D2 as a standard kit is limited in the number of programs which can be written.

The JBug monitor program is very efficient in developing and debugging user programs. The keyboard has 16 keys

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labeled 0-F for entry of hexadecimal addresses and data, and eight keys for commanding the following functions:

- M - Examine and Change Memory
- E - Escape (Abort) from operation in progress
- R - Examine contents of MPU registers, P,X,A,B,CC,S
- G - Go To specified program and begin execution of program
- P - Punch Data from memory to magnetic tape (Kansas City Standard)
- L - Load Memory from magnetic tape (Kansas City Standard)
- N - Trace one instruction
- V - Set (and Remove) Breakpoints

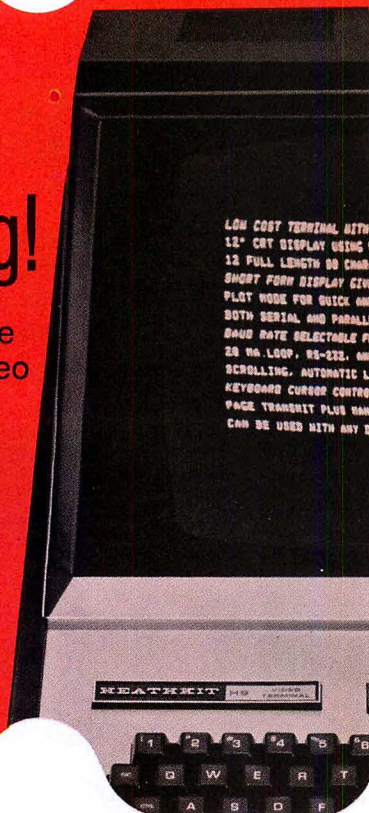
Operating procedures for each of these functions are detailed in the following paragraphs. The display should be showing a "dash" before any command is invoked.

EXAMINE AND CHANGE MEMORY (M)— This function permits examination and, if necessary, change of memory locations. A map of MC6800 instructions is shown in Table 1 and Figure 1 and is useful in translating memory data into instruction mnemonics. Open the memory location to be examined by entering the address (as 4-digits of hex via the hex keyboard) followed by the closure of the M key (hhhhM).

The display will now show the address that was entered in its group of four displays on the left and the contents on the right. The user at this time has three options: (1) Leave this location unchanged and move to the next location by closing the G key. The new address and its data will then be displayed. (2) Change the data by simply entering the new data via the hex keypad (hh). In this case the display would then be showing the new data that was entered. In the event that an attempt to change Read Only Memory (ROM), the display will continue to show the original data. (3) Close the Examine Memory function by means of the E key. Closure of the E key will return the operation to the monitor and the "dash" will again be displayed.

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ESCAPE (ABORT) (E)—This function provides an orderly exit from the other functions and/or user programs. Examples of its use are included in the accompanying descriptions of the other functions.

REGISTER DISPLAY (R)—This function permits the examination of the MPU's registers and may be used at any time the JBug dash is displayed by closing the R key. Following the closure of R, the display will show a four digit hex value, the present contents of the program counter. The remaining registers may now be examined by sequencing with the G key and will appear in the following order: Index Register, Accumulator A, Accumulator B, Condition Code Register, and Stack Pointer. The sequence is circular, in other words following the Stack Pointer, when the G key is pressed, the program Counter will again be displayed. The E key may be used to escape back to the monitor program.

GO TO USER PROGRAM (G)—If the dash is being displayed, and assuming a meaningful program has been previously entered, the MPU can be directed to go execute the program simply by entering the starting address of the program followed by the closure of the G key. The resulting blanking of the displays is an indication that the MPU has left the monitor program and is executing the user's program. The MPU will continue to execute the user's program until either an Escape (E key) is pressed or the program "blows." Control, indicated by the dash, can normally be obtained with the E key.

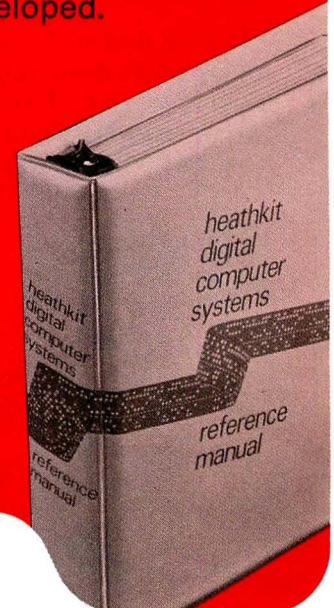
It is possible that an incorrect program could have caused the monitor's variable data to be modified. In this case, it is necessary to regain control using the reset switch on the Microcomputer Module.

PUNCH FROM MEMORY TO TAPE (P)—The Punch function allows the user to save selected blocks of memory on ordinary audio tape cassettes. Before using Punch, the Memory Change function should be used to establish which

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portion of memory is to be recorded. Using Memory Change, enter the desired starting address into locations A002 and A003 hex (high order byte into A002). Similarly, enter the high and low order bytes of the ending address into A004 and A005 (hex) respectively. Escape from Memory Change via the E key, thus obtaining the monitor dash. With the Audio recorder's microphone input attached to the corresponding point on the Keyboard/Display Module and the dash present, the Punch function is performed as follows: Position the tape as desired (fully rewound is recommended) and put the recorder in its record mode. Close the P key. The dash will disappear during the Punch process and then reappear to indicate that the Punch operation is completed. Typically, the dash is off for over 30 seconds since the recording format specifies that a thirty second header of all "ones" be recorded ahead of the data.

LOAD TAPE FROM MEMORY (L)—The Load function can be used to retrieve from audio magnetic tape data that were recorded using the punch function described in the preceding section. With the audio recorder's earphone output connected to the corresponding input on the Keyboard/Display Module and with the dash displayed on the display indicators, the Load function is performed as follows: To Load the desired record, position the tape at the approximate point from which the Punch function was started and put the recorder into playback mode. Close the L key. The dash will disappear, then reappear when the Load function is completed. After the dash reappears, the Memory Examine function can be used to examine the locations A002 and A003 (hex). They will contain the beginning address of the block of data that was just moved into memory. The end address is not recovered by the function, hence the data in addresses A004 and A005 (hex) are not significant during the Load function.

BREAKPOINT INSERTION AND REMOVAL (V)—Because of the difficulty in analyzing operation while a program is running, it is useful to set breakpoints at selected places in the pro-

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gram. This enables the user to run part of the program, then examine the results before proceeding. The Breakpoints are set by entering the hex address of the desired breakpoint followed by a V key closure. This may be repeated up to five times. The Breakpoint entry function can be exited after any entry by using the E key. The monitor program will retain all the breakpoints until they are cleared.

If at any time a V entry is made and the hex data does not appear on the display, there were already five breakpoints stored and the last one was ignored. At any time the dash is displayed, entry of a V command not preceded by the hex data, will cause the current breakpoints to be removed. If a breakpoint is entered and the program is subsequently executed to that point, the data will show the current value of the Program Counter in the four indicators on the left. (This will be the same as the breakpoint address that was inserted). The right hand two displays will contain the data stored at that location—that is, the operating code. At this point the G key can be used to sequence through the other MPU registers exactly as in the register display function. If it is desirable to proceed on from the breakpoint simply use the E key to get the dash and then the G key. At this point, the MPU will reload its registers from the stack and continue with the user's program until another breakpoint is encountered or the E key is used again.

TRACE ONE INSTRUCTION (N)—The Trace function permits stepping through the program one instruction at a time. The Trace function can be invoked at any time the user program is at a breakpoint or has been aborted with the E key. However, tracing cannot begin from start-up because the trace routine does not know where the start address is. Therefore, a V command must be given at least once before Trace can be used.

Enter the Trace function by first setting a breakpoint at the location from which it is desired to trace and then invoking a G key to begin the program execution. The

breakpoint can be set at the very beginning of the program if desired. Following the G command, the program will run to the breakpoint and stop, displaying the Program Counter as before. If the N key is now closed, the MPU now executes the next instruction and again stops. The display will then show the address of the next instruction and operating code located there. The G key can be used to sequence the other registers onto the display as for a breakpoint if desired. The N key can now be used as many times as desired.

The Trace function cannot be used directly to trace through user IRQ interrupts. The NMI is higher priority and will cause the IRQ to be ignored. Repeated attempts to execute the Trace command when user IRQ interrupts are active will result in JBug continuously returning with the same address.

SUMMARY

The MEK6800D2 Evaluation Kit is very impressive as a basic learning tool in microcomputers. Although a beginner entering into the realm of personal computing may find himself somewhat lost after finishing the check-out offered by the manual. Further information would help make this \$235 investment useful. Section 2.8 on Kit Expansion is vague without further information. Perhaps, were Motorola to offer more details on the EXORcisor in the form of brochures and applications, it would help the purchaser see the capabilities of this kit. Improvements on the basic kit literature could take the form of sample programs, application notes, with schematics, which the user could incorporate without the imminent expense of peripheral devices.

The MEK6800D2 may be purchased from local distributors or from Motorola Semiconductor Products, Inc., P.O. Box 20916, Phoenix, AZ 85036. (602) 244-3464. Price \$235.

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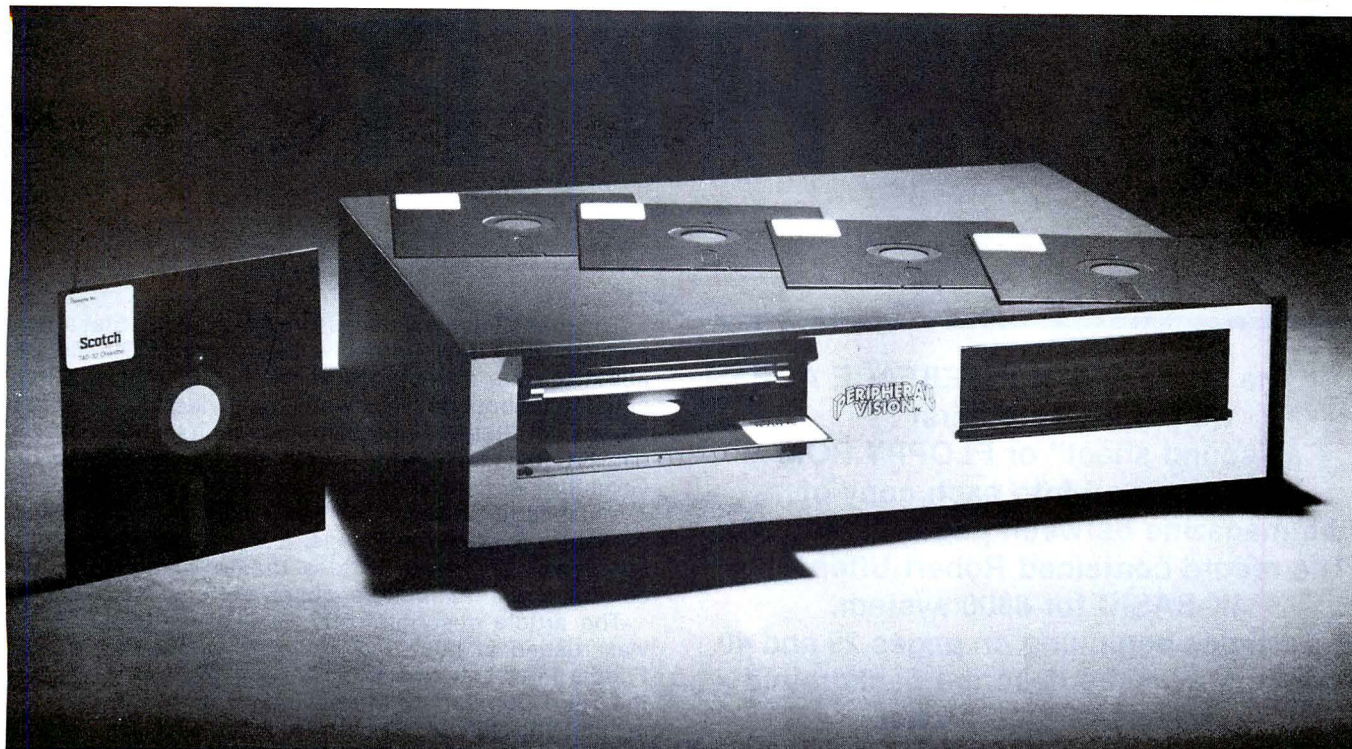
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Further Notes on FLOPPY ROM™

by William Blomgren

In the May issue of **INTERFACE AGE**™ we published a "first" — a "sound sheet" or **FLOPPY ROM** was inserted into each copy of the magazine between pages 32 and 33. The record contained Robert Uiterwyk's 4K BASIC for 6800 system. The articles beginning on pages 29 and 40 of the May issue describe background and use of the platter.

The rush of activity necessary to finish the first article resulted in a few unresolved questions. The first is about the life expectancy of the FLOPPY ROM. I indicated that about 30 plays would be expected. The actual lifespan of these will probably be much longer, but they can be damaged easily if they get folded or pinched. Given proper care, they may last several hundred plays. A fold is fatal, however. We had one on display at Microcomputer Systems in Tampa. It was handled carefully, but it was destroyed in less than a week. If you are careful, it will last quite a while.

The article describing 4K BASIC on FLOPPY ROM was rushed at best. Naturally, as with all rush jobs, Fudd's First Law of Partial Paper Loss combined with the Third Corollary to Murphy's Fourth Law (that which is most vital will be left out). This caused a loss of some data that was to be with the article. The listing of pointers, and the external routine calls got left out. They are vital to the care and feeding of 4K BASIC on systems without MIKBUG®. Hopefully, these comments will make things a bit clearer.

Several subroutines in MIKBUG® were used. Copies of these routines may be found in Motorola Engineering Note #100, which is a listing of MIKBUG®. The routines are shown in Figure 1. Here is a short summary of the external subroutines, and a short explanation of what they do.

The first of these routines is "OUT2H." This routine prints the contents of memory pointed to by the index register. The contents are printed as two HEX characters. The index register is incremented before returning. A comparable routine should be found in almost all operating systems. The jump location is:

0272 (HEX): 7E, E0, BF

EOBF is the location of OUT2H in MIKBUG®, 7E is the jump instruction.

The second external routine called is "OUT4HS." This routine will print 4 HEX characters by calling the OUT2H routine twice. It then outputs a space. Again, there is an equivalent in almost all operating systems. This routine returns the Index Register incremented twice. The instruction is located at:

0275: 7E, E0, C8

E0CB is the address of OUT4HS in MIKBUG®.

The input and output routines in MIKBUG® are also used. INEEEE and OUTEEE transfer one character through 'A' when called. It should be noted that the control port on a MIKBUG® equipped system is a 'bit-banger' and thus may have different status bits than an ACIA. The jump locations are:

INEEE:

027D: BD, E1, AC (Note it is a jump to subroutine)

OUTEEE:

027A: 7E, E1, D1 (Note that this is a jump)

0272	7E	E0BF	OUT2H	JMP	\$E0BF	OUT2H IN MIKBUG
0275	7E	E0C8	OUT4HS	JMP	\$E0C8	OUT4HS IN MIKBUG
0278	8D	09	OUTCH	BSR	BREAK	
027A	7E	E1D1		JMP	\$E1D1	OUTEEE IN MIKBUG
027D	BD	E1AC	INCH	JSR	\$E1AC	INEEE IN MIKBUG
0280	36			PSH A		
0281	20	08		BRA	BREAK0	
0283	36		BREAK	PSH A		
0284	B6	8004		LDA A	\$8004	
0287	2B	09		BMI	BREAK1	
0289	8D	F2		BSR	INCH	
028B	81	03	BREAK0	CMP A	#\$03	
028D	26	03		BNE	BREAK1	
028F	7E	0815		JMP	READY	NOTE READY LOCATION
0292	32		BREAK1	PUL A		
0293	39			RTS		DONE

Figure 1.

Robert Uiterwyk's 4K BASIC

Figure 1 shows the block of code containing these calls. This figure also has a listing of the break routine. If you are using an ACIA, it will be necessary to change the break routine to check for your status. You will probably have to add a short subroutine to the end of BASIC.

Another not-so-critical patch location is the carriage return-line feed string. The 15(HEX) is the erase to end of line character on a SWTPC CT-1024 terminal. This may be changed as necessary to allow an erase on your terminal. The string is located at:

02AC: 0D, 0A, 15, FF, FF, FF, FF, 1E

If you have to add a routine to the end of BASIC, the pointer for the beginning of program storage must be changed, or BASIC will dramatically change your code! The locations you must change are:

07F9, 07FA

They currently contain 1200 HEX. You would have to change the contents of these locations to point at a location after your routine(s). Any routines that you have to add, should be located beyond 1200.

Stack load and store operating may have to be changed if you don't have memory from A000 to A07F. There are four stack pointer instructions of note. These all load the stack pointer with A045 HEX. These locations are:

080F, 0848, 0B16, 0CC3

There is also a pair of stack references in the patch command routine. The first is at 08F8. This contains A040 currently. The instruction is located in 08FB then stores the stack in A008. Note... the "Patch" command has another jump that may have to be changed if you don't have MIKBUG. 08E3 contains the jump to MIKBUG. It contains E0E3 currently. Change this to the equivalent in your monitor.

There is an index register stack which has one reference. The index register stack sits at the top of MIKBUG's scratchpad. Location 0819 contains the Value A07F. Move this elsewhere as necessary.

There is a store index register command in the "Patch" routine. It is located at 08F5, and contains an A046. This location is the top of the stack, so the 'G' command will cause a return to BASIC.

Figure 2 shows a possible break routine for those with an ACIA for input. Note that it will not fit in the room that the current break routine occupies. Change the current break to have a jump subroutine at 1200 HEX. A return would follow that.

Figure 3 is a command listing of the biload program. It may be 'patched' to fit into most operating systems, and will be quite easy to implement on a system using an ACIA. The data is transferred through the A accumulator. In MITS 680 systems, you will have to transfer from B to A because they use B for input and output. The place to put your input one character routine call is INCHP. Load your BILOAD equivalent, then execute it. It will ignore the BILOAD program on the FLOPPY ROM and load BASIC (hopefully).

Enjoy the experiment.

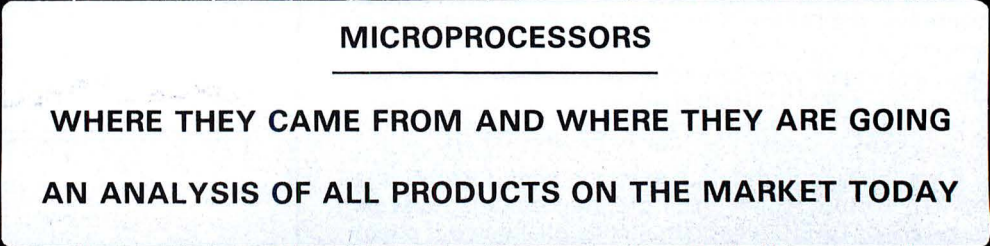
00010		NAM	BREAK	
00020		OPT	0	
00021	0B15	READY	EQ0	40B15
00022	E000	PORT	EQ0	4E000
00030	1200		ORG	41200
00050	1200 3A	BREAK	PSH A	
00060	1201 B6 E005		LDA A	PORT
00070	1204 48		ASL A	
00080	1205 24 0C		BCC	RETURN
00090	1207 B6 E001		LDA A	PORT+1
00100	120A B4 7F		AND A	447F
00110	120C B1 03		CMF A	4403
00120	120E 26 03		BNE	RETURN
00130	1210 7E 0B15		JMP	READY
00140				
00150	1213 32	*	RETURN	FUL A
00160	1214 39		RTS	
00999		END		GO BACK AGAIN...

Figure 2.

00030		NAM	BILOAD	
00040		OPT	L	
00290	19A4 8E 1500	BILOAD	LDS	41500
002B0	19A7 BD 49		BSR	LOAD
002B10	19A9 BD 3C	OVER	BSR	INPUT
002B20	19AB 81 58		CMF A	41X
002B30	19AD 26 FA		BNE	OVER
002B40	19AF BD 36		BSR	INPUT
002B50	19B1 81 31		CMF A	411
002B60	19B3 27 07		BLQ	READ
002B70	19B5 81 39		CMF A	419
002B80	19B7 26 F0		BNE	OVER
002B90	19B9 7E E0F3		JMP	CONTROL
002B95		2B95 *		
02910	19BC 7F 17FF	READ	CLR	CKSM
02920	19BF BD 26		BSR	INPUT
02930	19C1 16		TAB	
02940	19C2 5C		INC B	*
02950	19C3 8D 22		BSR	INPUT
02960	19C5 B7 1800		STA A	TW
02970	19C8 BD 1D		BSR	INPUT
02980	19CA B7 1801		STA A	TW+1
02990	19CD FE 1800		LDX	TW
03010	19D0 BD 15	STORE	BSR	INPUT
03020	19D2 A7 00		STA A	X
03030	19D4 01		NOB	
03050	19D5 A1 00		CMF A	X
03060	19D7 26 0B		BNE	OUT
03070	19D9 0B		INX	
03090	19DA 5A		DEC B	*
03100	19DB 26 F3		BNE	STORE
03110	19DD BD 08		BSR	INPUT
03120	19DF 7C 17FF		INC	CKSM
03130	19E2 27 C5		BEQ	OVER
03140	19E4 7E E040	OUT	JMP	LOAD19
03150	19E7 BD 14	INPUT	BSR	INCHP
03160	19E9 36		PSH A	*
03170	19EA B8 17FF		ADD A	CKSM
03180	19ED B7 17FF		STA A	CKSM
03190	19F0 32		FUL A	*
03200	19F1 39		RTS	
03220	19F2 B6 11	LOAD	LDA A	4111
03230	19F4 BD E1D1		JSR	OUTSEE
03240	19F7 B6 3C		LDA A	413C
03250	19F9 B7 8007		STA A	8007
03260	19FC 39		RTS	
3271 *		NOTE...IF YOU HAVE A ROUTINE THAT WILL		
3272 *		INPUT A FULL B BIT WORD WITH PARITY		
3273 *		CALL YOUR ROUTINE IN PLACE OF INCHP...		
3274 *		FOR EXAMPLE...		
3275 *	INCHP	PSH B		PROTECT B
3276 *	JSR	INCHP		THIS IS YOUR ROUTINE
3277 *		FUL B		GET B BACK
3278 *		RTS		
3279 *		PROTECT INDEX REGISTER AT ALL TIMES!!!		
3280 *	PSH B	*		THIS IS ALMOST SAME
3281 *	JSR	SAV		AS MIKBUG, BUT SAVES PARITY
3282 *	LDA A	X		BIT. SEE MOTOROLA ENG.100
3283 *	BMI	INT		FOR DETAILS OF HOW IT WORKS
03330	1A05 6F 02		CLR	2+X
03340	1A07 BD E1F3		JSR	DE
03350	1A0A BD E1EF		JSR	DEL
03360	1A0D C6 04		LDA B	44
03370	1A0F E7 02		STA B	2+X
03380	1A11 58		ASL B	
03400	1A12 BD E1EF	IN3	JSR	DEL
03410	1A15 0B		SEC	
03420	1A16 69 00		ROL	X
03430	1A18 46		ROR A	
03440	1A19 5A		DEC B	
03450	1A1A 26 F6		BNE	IN3
03460	1A1C BD E1EF		JSR	DEL
03470	1A1F 7E E1E3		JMP	10012

Figure 3.

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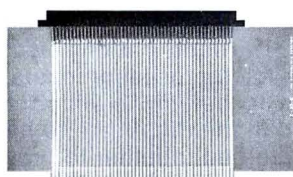
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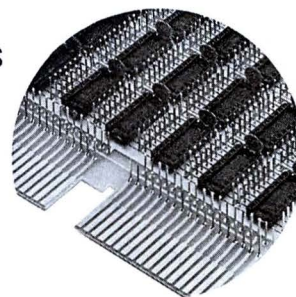


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MICROCOMPUTERIZED

by William A. Fox and Hasmukh M. Patel

The era of replacing cumbersome and bulky mechanical hardware with low cost, reliable electronics is here. The new application of electronics replacing mechanical logic or machine varies from so-called sophisticated accounting machines and cash registers to Penny Arcade games and numerous security devices. The rapidly advancing integrated circuit technology and the introduction of extremely inexpensive microprocessors provide great flexibility to users and are playing important roles in simple logic replacement.

This article describes the construction of very low-cost microprocessor-controlled programmable flexible combination lock. The microprocessor used in this design is National's SC/MP-II which is a general purpose 8-bit device built with state of the art N-CH silicon gate ion-implanted technology. The SC/MP-II operates with a single +5v power supply with low power dissipation (250 mw). The clocking mechanism is on chip requiring only crystal or R-C network for timing generation, and needs minimum external components. The sufficient on-chip input/output pins allow selection of combination and un-lock signal. The 256x8 bipolar prom (74 S 471) contains program from SC/MP-II and up to eight different combinations. In very simple systems as shown no RAM is required since the registers in SC/MP-II provide sufficient temporary data storage. The 74 LS257 multiplexes the PROM data and keyboard data to the CPU. The complete schematic for design is shown in Figure 1.

Since the program is stored in non-destructive bipolar PROM/ROM and the power dissipation of CPU is considerably low and all components require standard +5v supply, the battery operation of such system is highly desirable.

The battery-operated combination lock system is ideal for automobiles to prevent or reduce theft and at the same time, programmed sequence of combinations may prevent the owner of the vehicle from operating the car under the heavy influence of alcohol. The actual breadboard of flexible combination locks including all

required IC's, keyboard and battery pack is shown in Figure 2. The prototype breadboard uses LED for simplicity to indicate whether the lock is open or closed rather than actual solenoid or relay.

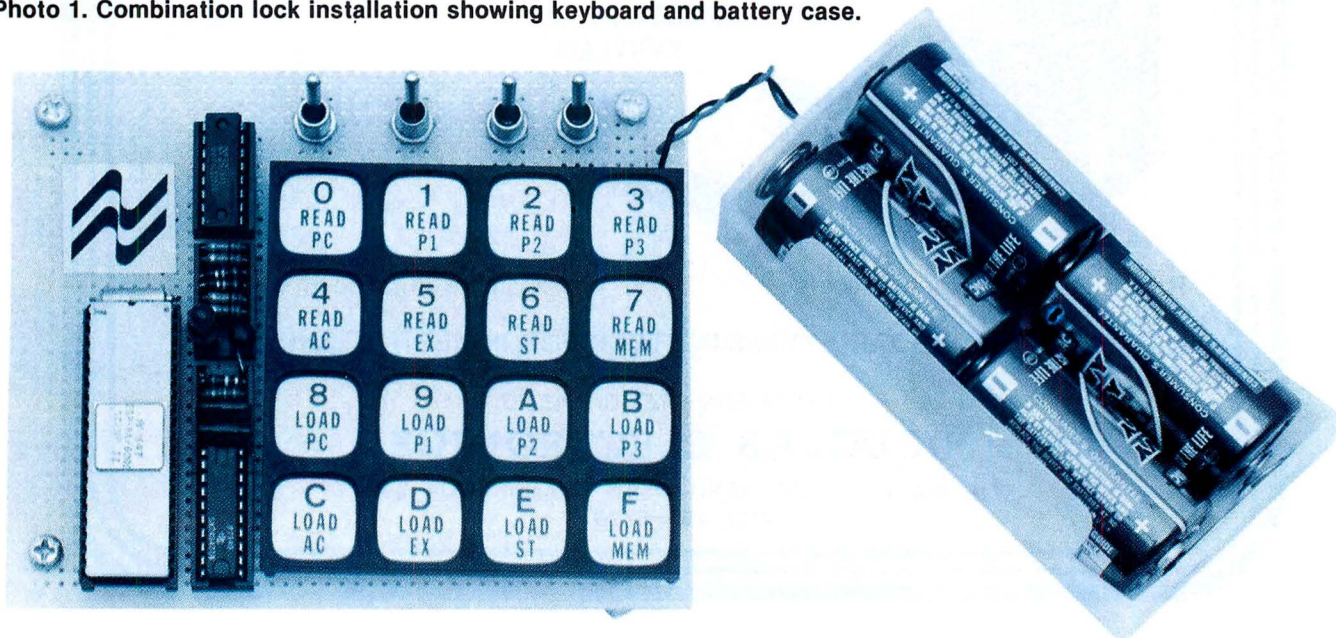
The keyboard is a simple calculator type with single-pole, single-throw switches. No switch debounce logic is required since all debouncing is done by the microprocessor. Any keyboard with up to twelve keys could be used. A keyboard similar to a pushbutton telephone with the ten digits plus '#' and '*' keys would be an excellent choice.

The resistors and capacitors tied between XIN and XOUT were chosen to provide approximately a 2-MHz clock. The combination select switches are tied to three of the microprocessor inputs. The program reads these inputs to determine which of the eight combinations stored in the PROM are to be used. The F1 and F2 outputs are tied together to provide better drive capability for the unlock signal. These outputs remain at a logic low until the proper combination has been entered. They will then both go to a logic high and remain until any key is depressed. The resistor and capacitor on NRST provide a power-on reset for the microprocessor. This insures that the unlock signal will not turn on falsely when power is restored after being off.

The keyboard is configured as an x-y matrix. Rows are selectively driven low by address lines while the columns are read into the microprocessor over the data bus. If no keys in the selected row are depressed all four column outputs will be pulled high by the pullup resistors. When a key is depressed, its respective column output is pulled low and sensed by the microprocessor. By knowing which row and column the closure is in, the microprocessor is able to look up in a table the proper key code.

The flow chart in Figure 2 shows how the microprocessor is programmed. Figure 3 shows the actual SC/MP program in detail. The power on circuitry tied to NRST insures the program will always begin execution at START. The first action is to set F0 (general

Photo 1. Combination lock installation showing keyboard and battery case.



COMBINATION LOCK

purpose flag 0) to a "one" to indicate the reset state. The reset state is entered any time an invalid key code or an incorrect digit in the combination is entered. Although there is no special reset key, any key not included in the combination may serve as a reset. Thus different combinations may each have different reset keys. It is necessary to enter the reset state before the combination is entered.

Since the time required for the microprocessor to execute the entire program will usually be less than the total time a key is depressed, the next section is a key release routine. As long as a key is depressed, the program stays in a tight loop until the key is released. It then waits approximately seven milliseconds and then checks to see that it is still released. If it is, then the program advances to the key depression routine. This is a similar routine except that it makes sure a key is

tables. The table selected is determined by the logic levels present at SA and SB. Each table contains two combinations. Since the key code is a 4-bit value, one combination is stored sequentially in the four more significant bits and the other is stored in the four less significant bits. The final action before making the comparison is to leave the reset state by setting F0 to a zero.

The current key is now compared to the proper half of the byte pointed to by P1. The proper half of the byte is determined by the SIN input. If the key code does not agree with the combination digit, then the program returns to the reset state. If it does compare, then it must check to see if the entire correct combination has been entered. If it has not, then the program goes back through the key release routine to accept the next key input. Consequently every time a key is depressed the entire program loop is repeated. The end of the com-

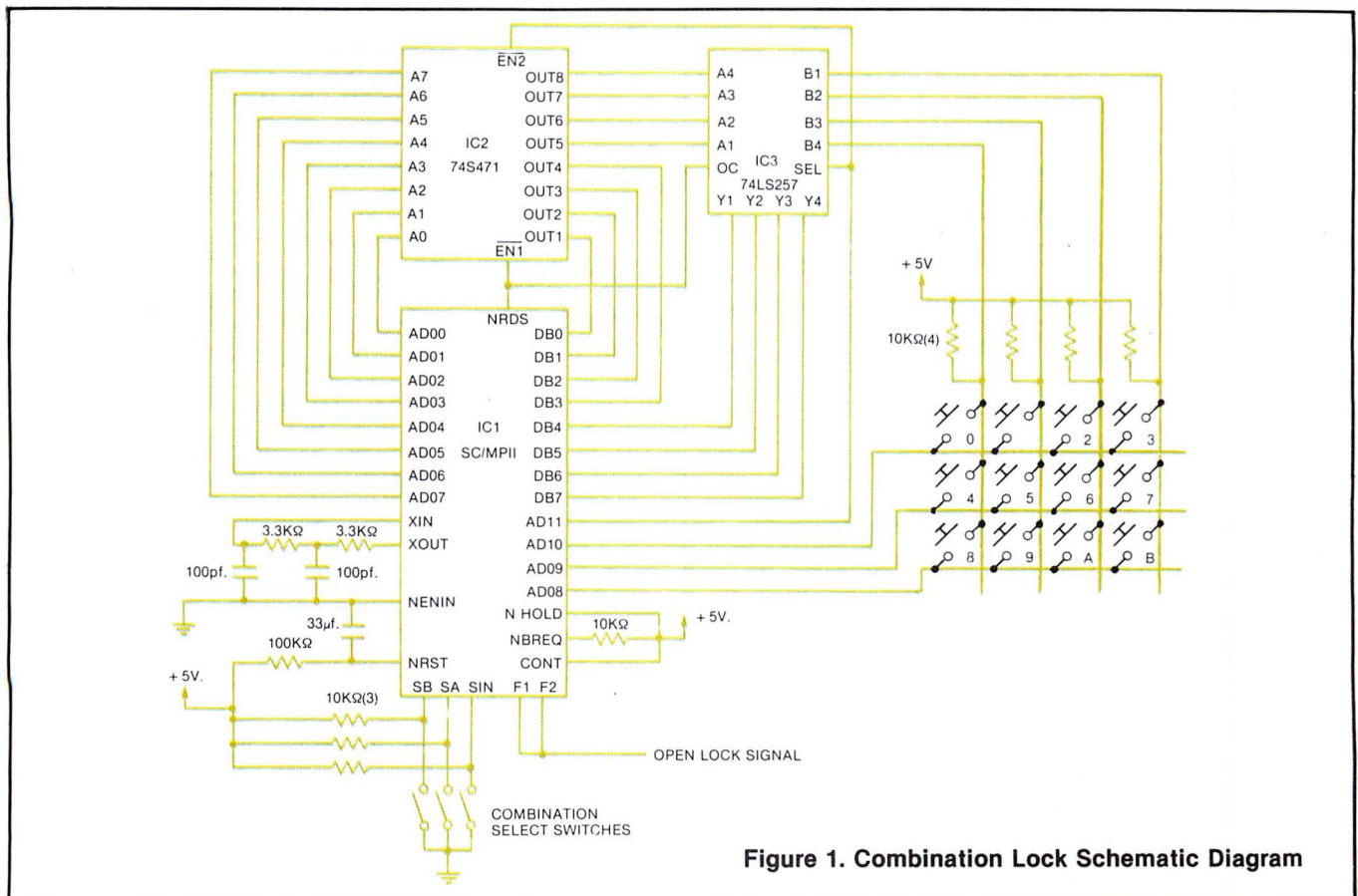


Figure 1. Combination Lock Schematic Diagram

depressed for seven milliseconds to account for switch bounce. The first action taken when a key is detected is to turn off the unlock signal. This is always done when a key is depressed to simplify the program, but of course, only has an effect when the unlock signal was already on. A look-up table is searched, using the column and row of the key depressed to encode a 4-bit key code. If the row-column combination is not found then an invalid key is assumed (which occurs for some multiple key closures) and the program goes to the reset state. If a valid key code is detected then the program advances to a section that compares the key code to the next digit in the combination.

Before making the comparison the program checks for the reset state (F0 = 1). If it is in the reset state then the program initializes P1 (general purpose pointer register) to the beginning of one of four combination

binations determined by a unique code in the combination table. Thus each combination may be of any length up to 15 digits. Once all of the digits of the combination have been properly entered, general purpose flags 1 and 2 (F1 and F2) are turned on as the unlock signal. The program then jumps back to the reset state to await a new key entry. The unlock signal will therefore stay on until any key is depressed.

Figure 5 shows an example of how the combinations are programmed in the PROM. This is an example of one of the four tables. This is the table for the case when SB and SA are set low. For other values of SB and SA, A5 would be set equal to SB and A4 would be set equal to SA. Two combinations are stored in this table. One is in the left half of the byte and the other is in the right half of the byte. Selection of which half of the byte is used as the combination is determined by the logic level present

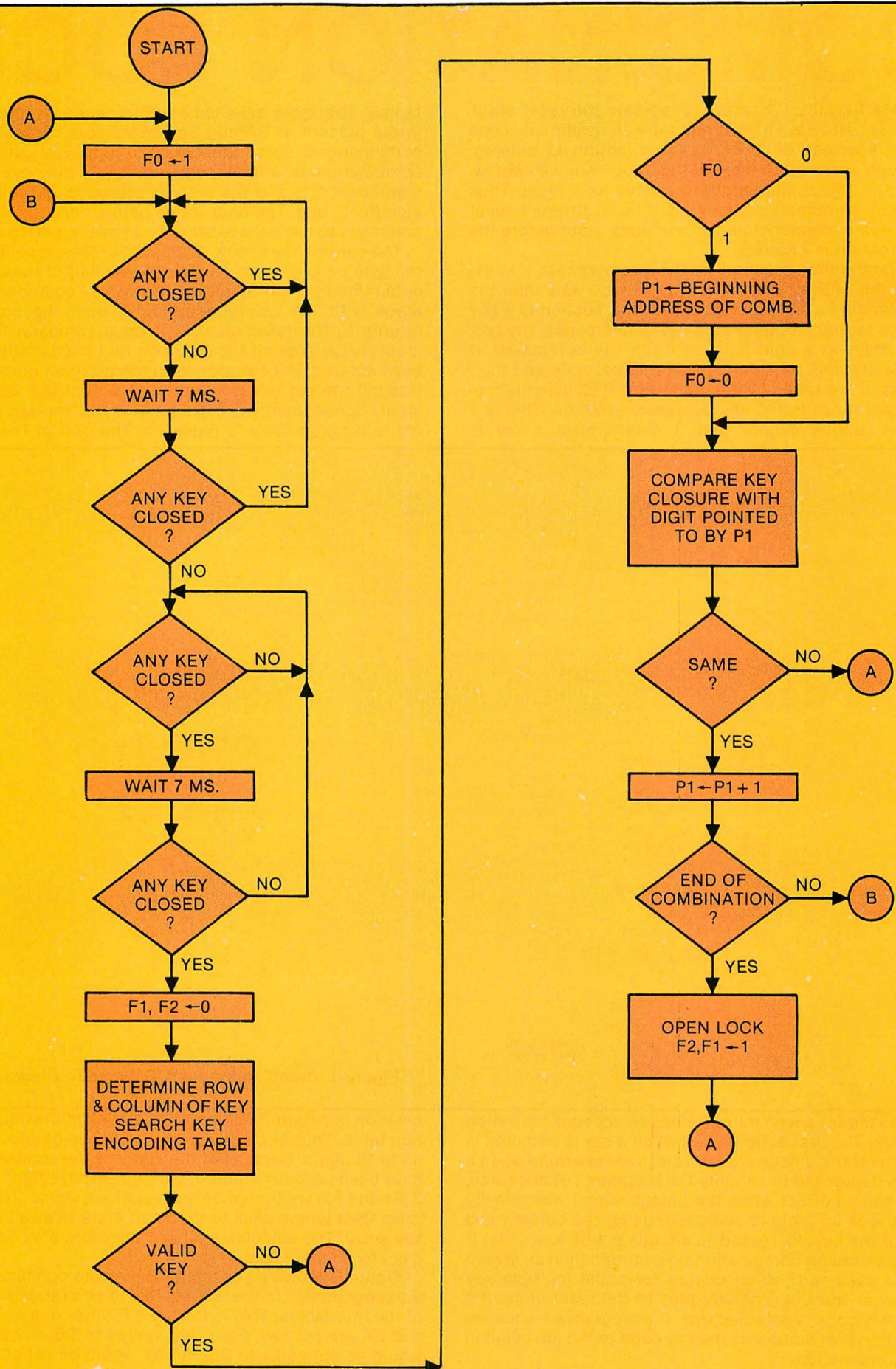
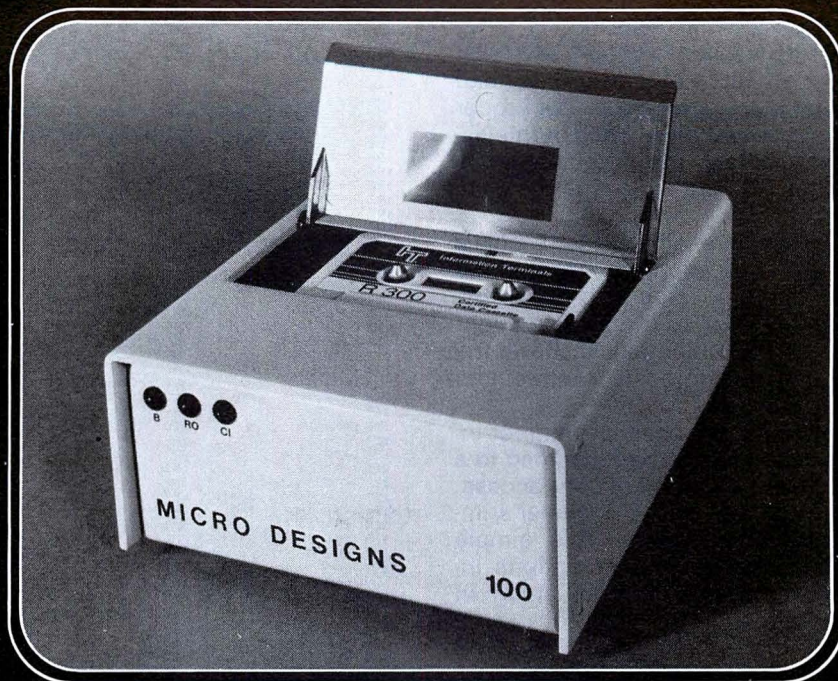


Figure 2. Combination Lock Flow Chart



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at SIN. When SIN is a logic low, the right half is used. When SIN is a high level, the left half is used. Each combination may be of any length up to 15 digits. The end of the combination is set by placing all 1's in the proper half of the byte right after the last digit. Thus in this example, when SIN is a logic low, the combination is 730492204961668 and when SIN is a logic high the combination is 4087376430.

The implementation shown here is meant to be only a starting point. The inclusion of a microprocessor in the combination lock opens many possibilities. For example, the addition of a C-MOS RAM to the system might allow the user to key in a new combination whenever the lock is opened which can be stored in for required length of time by battery backup.

Another possibility is to use this basic system for individuals to key in an access code to be forwarded to a central location that would either permit or deny access. The possibilities are limited only by the engineer's imagination in programming the system. This simple system may be expanded for many other options including turning on lights or sounding an alarm in response to lock tampering.

```

1      .TITLE LOCK, "SC/MP LOCK"
2
3      A SC/MP II, 256 X 8 PROM WITH THIS PROGRAM AND A
4      DATA2567 PROVIDE ELECTRONICS FOR A DIGITAL COM-
5      BINATION LOCK. UP TO A 12 KEY KEYBOARD MAY BE
6      USED FOR INPUT. ONE FROM MAY STORE UP TO EIGHT
7      DIFFERENT 15 DIGIT COMBINATIONS WHICH MAY BE
8      SWITCH OR JUMPER SELECTED.
9
10     ASSEMBLER DEFINITIONS
11
12     0001 P1 = 1
13     0002 P2 = 2
14     0003 P3 = 3
15     0007 DBT = 7 ; APPROXIMATE DEBOUNCE TIME
16                               ; IN MILLISECONDS
17
18     PAGE
19     0000 08 NOP
20     0001 06 RESET: CSA ; FLAG 0 (P0) INDICATES A
21     0002 0C01 ORI 1 ; RESET HAS OCCURRED
22     0004 07 CAS
23
24     SCAN KEYBOARD:
25
26     0005 C4F8 SCAN LD1 0F8 ; P2 IS SET UP TO
27     0007 36 XPAH P2 ; ADDRESS KEYBOARD
28
29     0008 C200 #10: LD 0(P2) ; MAKE SURE PREVIOUS KEY
30     0009 DC0F ORI 0F ; IS RELEASED BY PENDING
31     000C E4FF XRI 0FF ; ALL COLUMNS SIMULTANEOUSLY
32     000E 9CFF JNZ #10
33     0010 8F07 DLY DBT ; WAIT FOR DBT MILLISECONDS
34
35     0012 C200 LD 0(P2)
36     0014 DC0F ORI 0F
37     0016 E4FF XRI 0FF
38     0018 9CEE JNZ #10 ; IF KEY IS STILL DEPRESSED,
39                               ; IT WAS NOISE
40     001A C200 #20: LD 0(P2) ; LOOK FOR ANY DEPRESSION
41     001C DC0F ORI 0F
42     001E E4FF XRI 0FF
43     0020 98F8 JZ #20
44
45     0022 8F07 DLY DBT ; WAIT DBT MS.
46
47     0024 C200 LD 0(P2) ; SEE IF IT IS STILL
48     0026 DC0F ORI 0F ; THERE
49     0028 E4FF XRI 0FF
50     002A 98EE JZ #20 ; IF NOT, IT WAS NOISE
51
52     002C 06 CSA ; KEY IS DEPRESSED, SO
53     002D D4F9 ANI 0F9 ; TURN OFF OUTPUT
54     002F 07 CAS
55     0030 C4F8 LD1 0FB
56     0032 36 #30: XPAH P2
57     0033 C200 LD 0(P2)
58     0035 DC0F ORI 0F
59     0037 E4FF XRI 0FF
60     0039 9C06 JNZ FOUND
61     003B 36 XPAH P2
62     003C 1E RR
63     003D 940B JP #20
64     003F 90F1 JMP #20
65     0041 E4FF FOUND: XRI 0FF ; MERGE COLUMN/ROW ADDRESS
66     0043 01 XAE
67     0044 36 XPAH P2
68     0045 50 ANE
69     0046 01 XAE
70
71     0047 C400 LD1 H(TABL) ; SEARCH TABLE TO ENCODE
72     0049 36 XPAH P2 ; KEY CLOSURE
73     004A C48E LD1 L(TABL)
74     004C 32 XPAL P2
75     004D C602 #40: LD 0(P2) ; FETCH FIRST VALUE
76                               ; INCREMENT P2 BY 2
77     004F 98B0 JZ RESET ; ZERO INDICATES THE END
78                               ; OF THE TABLE. IF KEY
79                               ; CODE NOT FOUND THEN IT
80                               ; IS A RESET.
81     0051 60 XRE ; CHECK FOR COMPARE
82     0052 9CF9 JNZ #40 ; LOOP IF NOT EQUAL
83                               ; KEY CODE MAY NOW BE
84                               ; FETCHED BY LD -1(P2)
85
86     PAGE
87     ; COMPARE CURRENT KEY CODE WITH PROPER DIGIT
88     ; IN COMBINATION

```

```

89 0054 06 CSA ; FIRST TEST P0 TO SEE IF
90 0055 D401 ANI 1 ; THIS IS FIRST VALID KEY
91 ; SINCE RESET
92 0057 9800 JZ CHECK ; BRANCH IF NOT IN RESET
93 ; STATE
94
95 0059 06 CSA ; INITIALIZE P1 TO ORIGIN OF
96 005A D400 ANI 030 ; PROPER COMBINATION, DEFINED
97 005C DC00 ORI L(COMB) ; BY SB & SA
98 005E 31 XPAL P1
99 005F C400 LD1 H(COMB)
100 0061 25 XPAH P1
101 0062 06 CSA ; CLEAR P0
102 0063 D4FE ANI 0FE
103 0065 07 CAS
104
105 0066 C501 CHECK: LD 0(P1) ; COMPARE PROPER DIGIT
106 0068 E2FF XOP -1(P2) ; WITH KEY CODE
107 006A 19 SIO ; DETERMINE IF LEFT OR
108 ; RIGHT BYTE IS SIGNIFICANT
109 006B 01 XAE
110 006C 9405 JP #50
111 006E 01 XAE ; SIN=1 => LEFT BYTE
112 006F D4F0 ANI 0F0
113 0071 9002 JMP #60
114 0073 01 #50: XAE ; SIN=0 => RIGHT BYTE
115 0074 D40F ANI 00F ; RESET IF NO MATCH
116 0076 9C89 JNZ RESET
117
118 0078 19 SIO ; CHECK FOR END OF COMBINATION
119 0079 01 XAE
120 007A 9404 JP #70
121 007C C40F LD1 00F ; SIN=1 => LEFT BYTE
122 007E 9002 JMP #80
123 0080 C4F0 LD1 0F0 ; SIN=0 => RIGHT BYTE
124 0082 D500 #80: OR 0(P1) ; IF NEXT DIGIT IS 0 THEN
125 0084 E4FF XRI 0FF ; THE CORRECT COMBINATION
126 0086 9F04 JNZ SCAN(P3) ; HAS BEEN ENTERED
127 0088 06 CSA
128 0089 DC06 ORI 6 ; OPEN THE LOCK
129 008B 07 CAS
130 008C 9200 JMP RESET(P3)
131 ; PAGE
132 ; 'KEY ENCODING TABLE'
133 008E 7600 TABL: .DBYTE 07E00 ; 0
134 0090 B811 .DBYTE 08E11 ; 1
135 0092 0E22 .DBYTE 0DE22 ; 2
136 0094 EB33 .DBYTE 0EE33 ; 3
137 0096 7044 .DBYTE 07044 ; 4
138 0098 8D55 .DBYTE 0ED55 ; 5
139 009A D066 .DBYTE 0DD66 ; 6
140 009C ED77 .DBYTE 0ED77 ; 7
141 009E 7E88 .DBYTE 07E88 ; 8
142 00A0 BE99 .DBYTE 0BE99 ; 9
143 00A2 DEAA .DBYTE 0DEAA ; A
144 00A4 EEEB .DBYTE 0EEEB ; B
145 00A6 00 .DBYTE 0 ; 0 INDICATES END OF TABLE

```

ADDRESS								DATA									
BINARY								HEX	BINARY								HEX
A7	A6	A5	A4	A3	A2	A1	A0		B8	B7	B6	B5	B4	B3	B2	B1	
1	1	0	0	0	0	0	0	C 0	0	1	0	0	0	1	1	1	4 7
1	1	0	0	0	0	0	1	C 1	0	0	0	0	0	0	1	1	0 3
1	1	0	0	0	0	1	0	C 2	1	0	0	0	0	0	0	0	8 0
1	1	0	0	0	0	1	1	C 3	0	1	1	1	0	1	0	0	7 4
1	1	0	0	0	1	0	0	C 4	0	0	1	1	1	0	0	1	3 9
1	1	0	0	0	1	0	1	C 5	0	1	1	1	0	0	1	0	8 2
1	1	0	0	0	1	1	0	C 6	0	1	1	0	0	0	1	0	6 2
1	1	0	0	0	1	1	1	C 7	0	1	0	0	0	0	0	0	4 0
1	1	0	0	1	0	0	0	C 8	0	0	1	1	0	1	0	0	3 4
1	1	0	0	1	0	0	1	C 9	0	0	0	0	1	0	0	1	0 9
1	1	0	0	1	0	1	0	C A	1	1	1	1	0	1	1	0	F 6
1	1	0	0	1	0	1	1	C B	X	X	X	X	0	0	0	1	X 1
1	1	0	0	1	1	0	0	C C	X	X	X	X	0	1	1	0	X 6
1	1	0	0	1	1	0	1	C D	X	X	X	X	0	1	1	0	X 6
1	1	0	0	1	1	1	0	C E	X	X	X	X	1	0	0	0	X 8
1	1	0	0	1	1	1	1	C F	X	X	X	X	1	1	1	1	X F

Figure 3. Programming of Combinations

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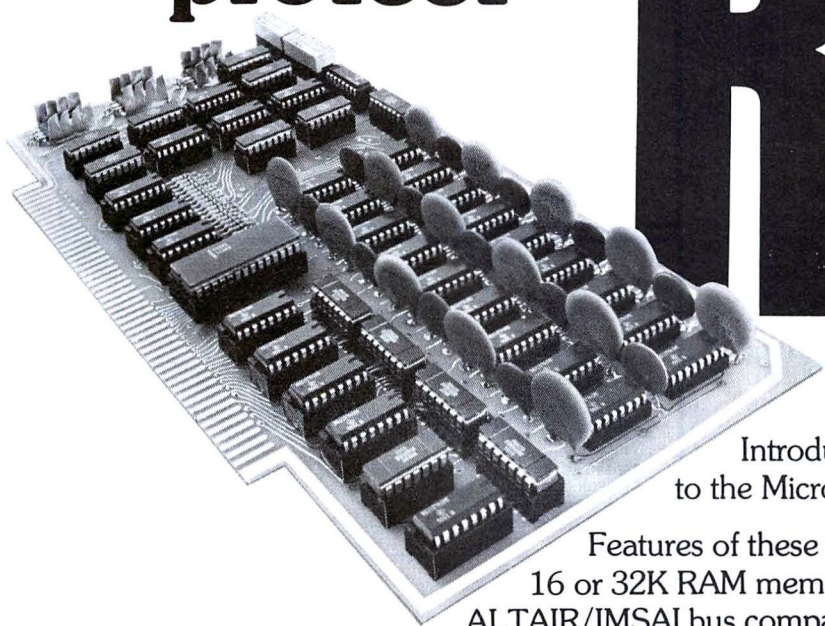
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SOME GUIDELINES FOR USERS OF THE RS-232 OR THE UART

by Michael Duncan

KEEPING THE RS-232 PINS STRAIGHT

The advent of EIA's RS-232 has greatly simplified the job of interconnecting terminals or computers (RS-232's data terminal equipment), modems (data communications equipment), and telephone lines. However, in these days of proliferating microcomputers we rarely find ourselves using a telephone line, rather find ourselves directly connecting micros to minis, and moving expensive peripherals around from computer to computer. Often in such simple systems only three signals are required: signal ground, transmitted data, and received data, and they use two 25-pin, D-series connectors, one male and one female. Nevertheless, it is remarkable how often equipment is miswired. Sticking to the convention below will guarantee that everything plugs into everything else:

1. Any unit which has a male connector is a "terminal." Pin 2 should be data transmitted from the unit; pin 3 should be data transmitted to the unit.
2. Any unit which has a female connector is a "modem." Pin 3 should be data transmitted from the unit, pin 2 should be data transmitted to the unit.

Some examples are shown in Figure 1. Keep some "null modems" and "null terminals" handy, as shown.

HANDSHAKING ASYNCHRONOUS SERIAL INTERFACES

Another shortcoming of RS-232 when used with directly connected units is that no handshaking signals on a byte-to-byte basis are defined. Although RS-232 provides a pair of signals called REQUEST TO SEND and CLEAR TO SEND, they are inadequate since they were intended to synchronize communication on a line-by-line or block-by-block basis. When you try to transfer text or binary files from one machine to another you find that:

1. Your real-time operating system is only real time most of the time.
2. A FIFO buffer wasn't designed into your terminal, but the vendor's new model XXX has it.

Often bytes are lost during transfer because the receiving end can't dispose of them in one-byte time. What is needed is a simple handshake to stop the transmitter between bytes when the receiver is temporarily full. The handshake should not require a modification to the driving software. The scheme shown in Figures 2 and 3 will do the trick. It is similar to one used by Nicoud¹, which he called SIMSER (SIMple SERIAL stan-

dard). It simply turns off the UART clock while the receiver disposes of the byte. One disadvantage of this is that a slight speed advantage afforded by the UART double buffering on input and output is voided, since the transmitter will always temporarily pause while the receiver's microprocessor fetches the last byte.

REFERENCES

Nicoud, Jean Daniel: Peripheral interface standards for microprocessors, *Proceeding of the IEEE*, Vol. 64, No. 6, June, 1976.

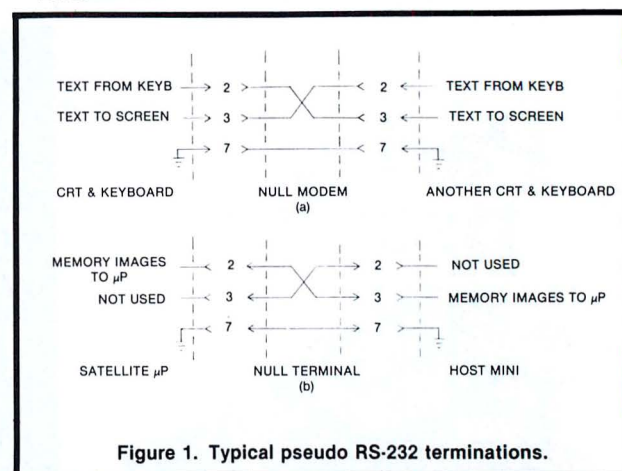


Figure 1. Typical pseudo RS-232 terminations.

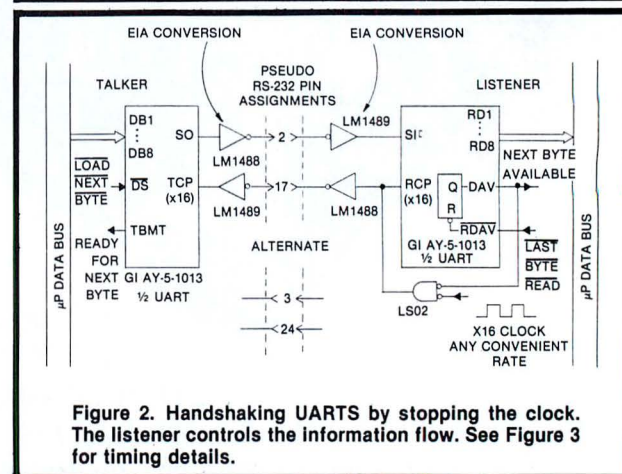


Figure 2. Handshaking UARTS by stopping the clock. The listener controls the information flow. See Figure 3 for timing details.

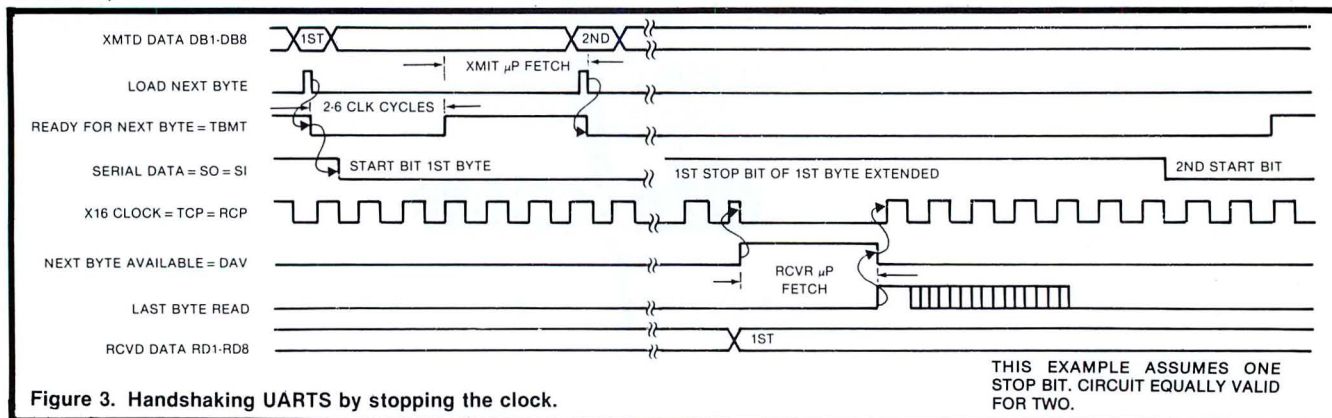


Figure 3. Handshaking UARTS by stopping the clock.

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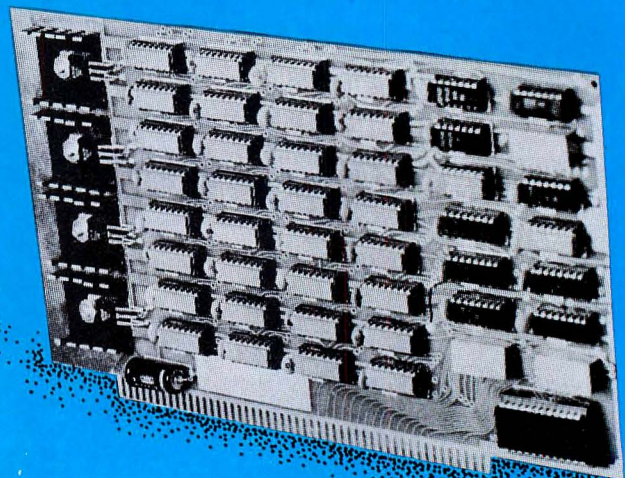
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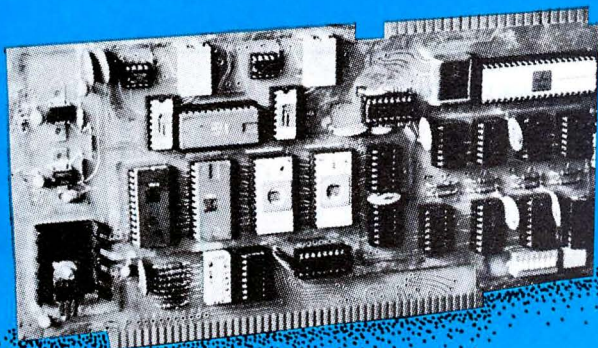
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Hardware Report

SERIAL/PARALLEL INTERFACING WITH THE WESTERN DIGITAL TR1863

by Roger H. Edelson, Hardware Editor

This month we will take a look at one of the many Asynchronous Receiver/Transmitter (UART) chips available, the Western Digital TR1863. In future columns I will explore some of the other UART's also available.

The UART is a general purpose — usually programmable — LSI (generally MOS) device for interfacing an asynchronous serial data channel with the parallel data channel of the computer. The serial data channel can feed a peripheral or a terminal. Since the serial data channel is asynchronous it is necessary that the transmitter section supply the start-and-stop bits necessary to decode the data stream. The receiver section must be able to accept the serial data stream and, using the start-and-stop bits, convert it into parallel data. In most cases the UART will supply the parity bit and be capable of checking parity, word framing, and word overrun.

Let's take a look at the features of the TR1863:

- 1) Directly TTL and CMOS compatible
- 2) Requires only a single +5 volt power supply
- 3) Only static circuitry is used
- 4) Capable of either full or half-duplex operation.
This means that it can transmit and receive either simultaneously or alternately.
- 5) Provides automatic start bit generation.
- 6) Automatic internal synchronization of data and clock.
- 7) Both the receiver and transmitter registers are double buffered — one buffer for data timing and one for interface level.
- 8) Programmable and externally selectable:
Word Length
Baud Rate
Even/Odd Parity
Stop Bit Generation (1-, 1½- or 2-bit)
- 9) Automatic Status generation for data received/transmitted:
Transmission Complete
Buffer Register Transfer Complete
Received Data Available
Parity/Framing/Overrun Error
- 10) Tri-State Outputs on Receiver Register and all status flags

The applications of this device include communication with card and tape readers, modems, terminals, keyboard encoders, peripherals, data cassettes, or any other asynchronous serial data device. Figure 1 provides the pin connections for the TR1863.

Let's take a look at the inside of the TR1863. Figure 2 provides a block diagram of the internal chip structure along with a partial circuit diagram of the tri-state output. If we begin our survey with the transmitter portion, we can see that there are four parallel data input lines (TR1-TR8) which are buffered inputs to the Transmitter Holding Register. The lines are buffered by input gates which must be strobed by a low level on the THRL

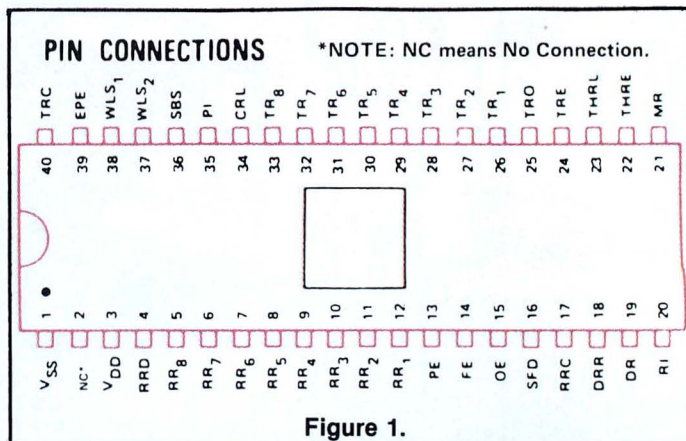


Figure 1.

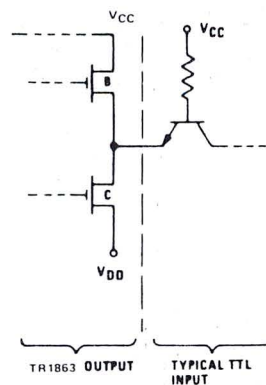
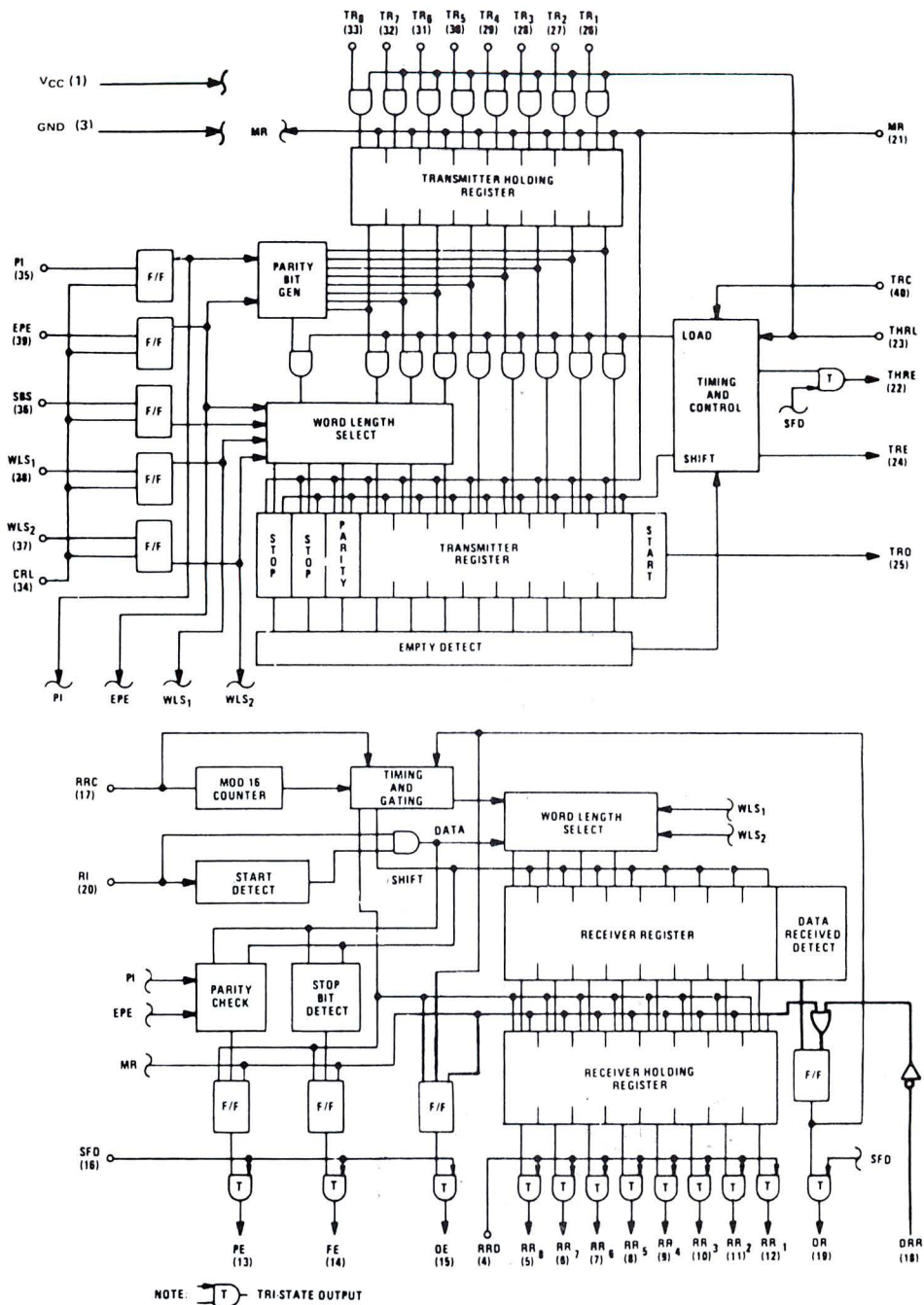
(Transmitter Holding Register Load) line before a character can be entered into the Transmitter Holding Register. The Transmitter Holding Register functions as a 1-bit buffer and a transition from the low to the high level on the THRL is necessary to place the data into the Transmitter Register. The timing and control circuits are arranged such that no transfer will take place if the Transmitter Register is in the process of transmitting a character. Upon completion of transmission the new character is automatically transferred simultaneously with the initiation of the serial transmission of the new character.

One of the interesting features of the chip is that when a character length of less than eight bits has been selected, the character presented on the data lines is right justified to the least significant bit and the excess bits are discarded. The character length is selected by WL1 and WL2. The following Table gives the code for word length selection:

WLS ₂	WLS ₁	Word Length
V _{IL}	V _{IL}	5 bits
V _{IL}	V _{IH}	6 bits
V _{IH}	V _{IL}	7 bits
V _{IH}	V _{IH}	8 bits

From the block diagram we can also see that the parity generator is tied in parallel to the output lines from the Transmitter Holding Register. Depending on the state of the Parity Inhibit (PI) and the Even Parity Enable (EPE) lines, this generator will automatically place a parity bit in the first position to the left of the last data bit. Again the word length select block performs this function of bit arrangement.

The Transmitter Register along with the Word Length Select function and the Stop Bit(s) Select (SBS) line determines the number of stop bits to be transmitted. If the SBS line is high two stop bits will be selected, and if the line is low a single stop bit will be selected. When

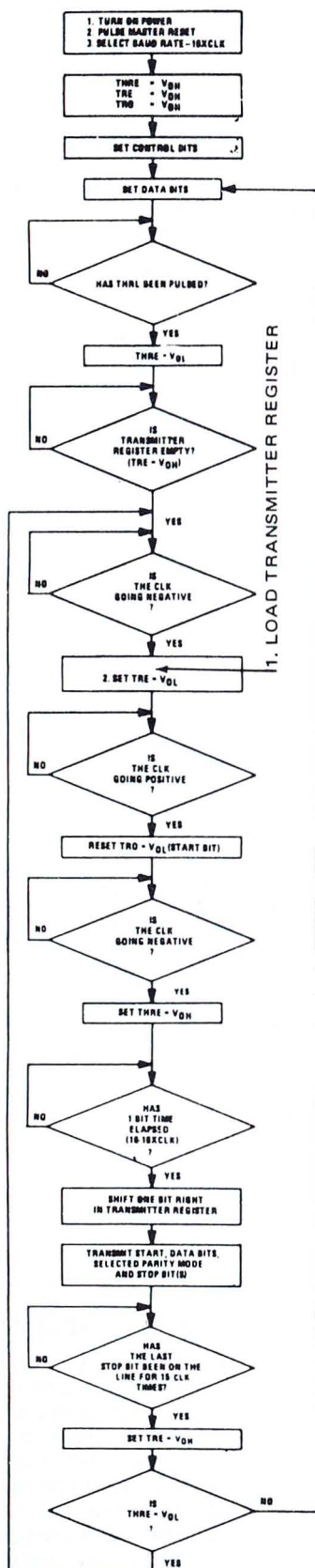


OUTPUT STRUCTURE

DEVICES "B" & "C" COMPRISE A PUSH-PULL OUTPUT BUFFER. IN THE LOW-LEVEL STATE, OUTPUT TRANSISTOR "C" IS "ON" AND CASCODE DEVICE "B" IS OFF. IN THE HIGH-LEVEL STATE, THE OPPOSITE IS TRUE. IN THE DISCONNECTED STATE, BOTH "B" AND "C" ARE TURNED OFF CAUSING THE OUTPUT NODE TO FLOAT.

Figure 2.

TRANSMITTER FLOW CHART



RECEIVER FLOW CHART

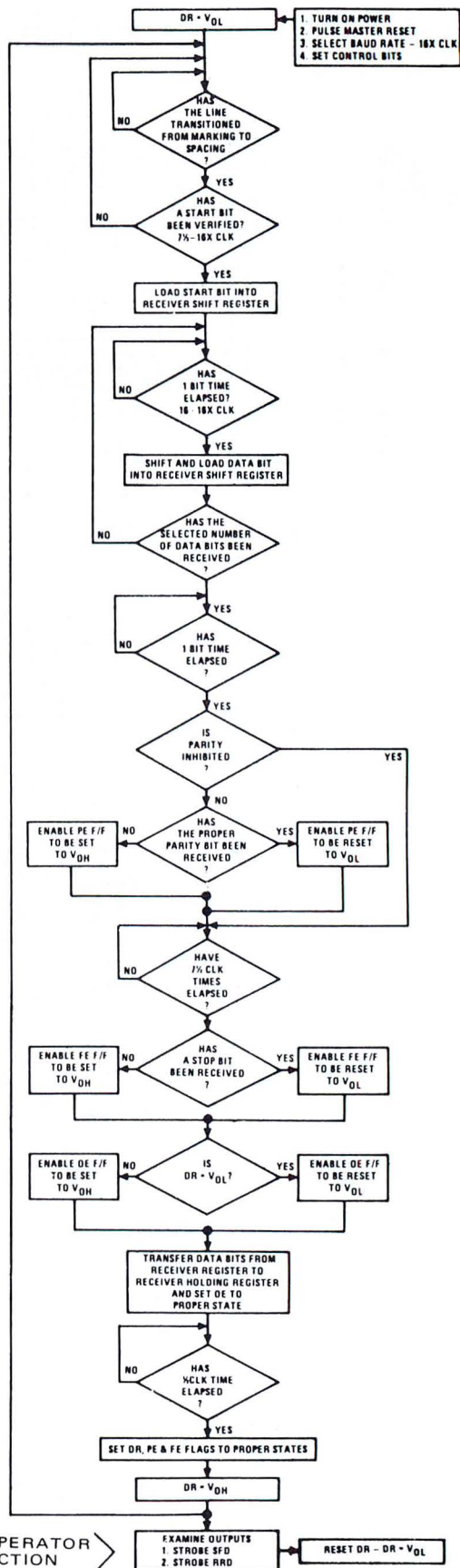


Figure 3.

the word length has been set to five bits, a high state on the SBS line will cause 1½ stop bits to be transmitted.

All of the function select lines are buffered by flip-flop inputs so that the conditions selected may be programmed. A high level on the Control Register Load line will load these control register flip-flops with the control bits (WLS₁, WLS₂, EPE, PI, and SBS). A low level on the CRL line prevents a change in the condition of the Control Register. If the CRL line is hard-wired to the high level input voltage, the control functions will be determined by the state of the control bit lines and no storage will take place. This allows hard-wiring of the control functions if program control is not desired.

The last block of the transmitter portion of the TR1863 is the "empty detect circuitry." The output of this circuitry produces the Transmitter Register Empty signal which indicates when the serial transmission of the full character, including the stop bit(s), is completed. The TRE line goes to high level upon completion of a transmission and remains at this level until a new character is transferred into the Transmitter Register and a new serial transmission is begun.

The receiver portion of the TR1863 begins with the MOD 16 Counter which is used to divide the receive clock (RRC) by 16 to get the desired bit shift rate. Other UARTs have programming capability for the clock-to-shift-rate division; on the TR1863 this division ratio is fixed. The outputs of the WLS₁ and WLS₂ control register flip-flops are also shared by the receiver word length select circuits. Hence, the control functions programmed or wired into the transmitter section are also inputted to the receiver section.

The serial data input to the receiver section are entered on the Receiver Input line. The start detect circuitry is used to detect the presence of the start bit. This information, along with the programmed word length is used to set the effective length of the Receiver Holding Register. Data are entered into the Receiver Holding Register at a point determined by the selected bit length of the word. The bits are then right shifted as each new bit is received. When all the bits of the word have been received the Data Received (DR) flag is set.

The Parity Check and Stop Bit Detect circuits are also connected to the data and shift lines. Depending on the status of the PR and EPE lines the Parity Check circuitry will indicate if there is a Parity Error. If a parity error has been detected, and the Parity Inhibit is not selected, the PE line will go high. The Stop Bit Detect circuit will indicate if no valid stop bit has been detected by placing a high level on the Framing Error line. This condition will exist if the last bit following the parity bit (if programmed) is not a high level.

The TR1863 also provides an Overrun Error output. This line will go high if the Data Received Flag was not reset before a new character was transferred into the Receiver Holding Register. The Data Received Flag is reset by applying a low level signal to the Data Received Reset line.

All the status flags may be disconnected from their output lines by means of a high level signal applied to their Tri-State control inputs. The line which provides this control is the Status Flat Disconnect (SFD) signal. The use of tri-state circuitry on the status flag outputs allows these lines to be bussed together when using arrays of UARTs.

A Master Reset line is provided to clear the UART. This signal, MR, when strobed to a high level clears all the registers, clears the control register, clears FE, OE, PE, DRR and sets TRO, THRE, and TRE to a high level.

The parallel data outputs of the TR1863 are provided by RR₁-RR₈. These lines are connected to the outputs of the Receiver Holding Register by means of tri-state buffers. The tri-state buffers are placed in their high im-

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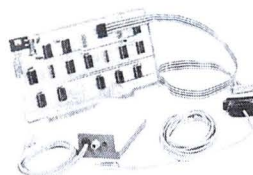
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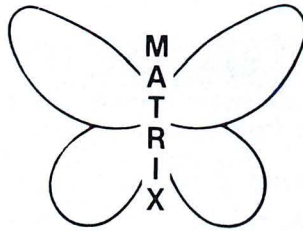
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pedance state by means of a high level signal on the Receiver Register Disconnect line (RRD).

The operation of the TR1863 chip is shown in flow chart fashion in Figure 3. The operation of the transmitter section begins with power turn-on. Master Reset must be pulsed (to reset all the internal registers) and then the baud rate will be externally determined as 16 times the clock rate. At this point the chip will set THRE, TRE, and TRO to a high level (V_{OH}).

Next, the control bits — and therefore the control register — must be set to their desired states. It is at this point that word length, parity condition, and stop bit number are selected. CRL must be placed high to enter the desired control conditions. This entry is not explicitly shown in the flow chart. The data bits are now presented to the Transmitter Holding register buffers. The chip then checks to see if the THRL line has been pulsed low. When this happens THRE is set low and the chip waits until the Transmitter Register is empty. Once the Transmitter Register becomes empty and the clock goes negative the data are shifted into the Transmitter Register from the Transmitter Holding Register. TRE is then set low to indicate that data are in, the Transmitter Register is now full and a new serial transmission has begun.

On the next half cycle of the clock (positive going) TRO is reset to begin the start bit, and when the clock again goes negative THRE is reset to a high so that another word may be loaded into the Transmitter Holding Register.

All the data bits are then serially shifted out of the TRO line until the stop bit is out. At this point, the chip resets TRE, and based on the condition of the THRE line, jumps back to one of the earlier conditions.

The receiver portion begins with the same set-up requirements as the transmitter section. Then operation must wait until a proper start bit has been identified. After the start bit is loaded into the register the rest of the data bits are serially shifted into the Receiver Register. Depending on the parity condition established, the parity bit is checked and the Parity Error flag may be set. A check for the stop bit is then made and the result of this test determines the condition of the Framing Error flag. Depending on the state of the Data Received flip-flop the Overrun Error flag is either set high or low.

Next the data bits are transferred from the Receiver Register to the Receiver Holding Register, and 1/2 clock later the DR, PE, and FE flags are set to their proper states. It is then necessary for the external circuitry to examine the outputs, and if a bus system is being used, strobe the Status Flag Disconnect, and the Receive Register Disconnect lines to place these signals on the system bus.

The timing of the 1/2 clock is shown in Figure 4. Two possible cases of transmitter timing are shown, depending upon the relation of THRL to the negative clock transition.

Table 1 lists the maximum ratings, and the electrical characteristics of the chip. Logic levels are both TTL and CMOS compatible. The chip outputs can drive one TTL load over the specified temperature range. The chip draws a maximum of 35ma from the 5 volt line for a maximum power dissipation of 175 mw.

The switching characteristics of the TR1863 are listed in Table 2. As can be seen the maximum clock frequency is 1 MHz, limiting the baud rate to 62.5 kHz with the exception of the Master Reset signal all the control lines must be pulsed for at least 200 nanosec. The Master Reset line must be strobed high for at least 500 nanosec. The THRL line may go low simultaneously with the presentation of valid data to the TR lines. The same is true of the CRL strobe pulse. The data lines and the

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control lines must be held in their previous states for at least 20 nanosec. after the THRL and CRL lines have gone to their non-strobed levels.

The TR1863 is a particularly easy chip to use. I have used it in a dedicated system for the transmission of data over the SMS (Synchronous Meteorological

Satellite) system. It is very advantageous not to have to produce logically the correct parity and set up the start and stop bit conditions. The chip is compatible with RS232 logic conventions, though RS 232 level converters must be used at the serial inputs and outputs of the chip.

Table 1.

MAXIMUM RATINGS

V _{CC} Supply Voltage	- 0.3V to + 7.0V
Clock Input Voltage*	- 0.3V to + 7.0V
Logic Input Voltage*	- 0.3V to + 7.0V
Logic Output Voltage*	- 0.3V to + 7.0V
Storage Temperature	- 55°C to + 150°C
Operating Free-Air Temperature T _A Range	0°C to + 70°C**
Lead Temperature (Soldering, 10 sec.)	300°C

*GND = 0V

NOTE: These voltages are measured with respect to GND

ELECTRICAL CHARACTERISTICS

$$V_{SS} = V_{CC} = 5V \pm 5\%, V_{DD} = 0V$$

$$T_A = 0^\circ\text{C to } +70^\circ\text{C unless otherwise specified)$$

SYM	PARAMETER	MIN	MAX	CONDITIONS
I _{CC}	OPERATING CURRENT Supply Current		35 ma	V = 5.25V
V _{IH}	LOGIC LEVELS Logic High	2.4V		
V _{IL}	Logic Low		0.6V	V _{SS} = 4.75V
V _{OH}	OUTPUT LOGIC LEVELS Logic High	2.4V		V _{SS} = 4.75V, I _{OH} = -100μa
V _{OL}	Logic Low		0.4V	V _{SS} = 5.25V, I _{OL} = 1.6 ma
I _{OS} *	Short Circuit Current		20ma	V _{SS} = 5.25V, V _O = 0V
I _{OC}	Output Leakage		10μa	V _{OUT} = 0V, SFD=RRD=V _{IH}
I _{IL}	Input Current		+10ua	V _{IN} = V _{IH} or V _{IL}

*Only one output should be shorted at any time.

**Consult factory for extended temperature range UARTS.

Table 2.

SWITCHING CHARACTERISTICS — See "Switching Waveforms"

$V_{CC} = 5V, V_{DD} = 0V$

$T_A = 25^{\circ}, C_{LOAD} = 20 \text{ pf plus one TTL load}$

SYM	PARAMETER	MIN	MAX	CONDITIONS
f_{clock}	Clock Frequency	D.C.	1.0 MHz*	$V_{SS} = 4.75V$
t_{pw}	Pulse Widths			(See figures 1 & 2)
	CRL	200 ns		
	THRL	200 ns		
	DRR	200 ns		
	MR	500 ns		
t_c	Coincidence Time	200 ns		(See figure 1 & 2)
t_{hold}	Hold Time	20 ns		(See figure 1 & 2)
t_{set}	Set Time	0		(See figure 1 & 2)
	Output Propagation Delays			
t_{pd0}	To Low State		250 ns	(See figure 3)
t_{pd1}	To High State		250 ns	$C_L = 20 \text{ pf, plus one TTL load}$ (See figure 3)
	Capacitance			$C_L = 20 \text{ pf, plus one TTL load}$
C_{in}	Inputs		20 pf	$f = 1 \text{ MHz}, V_{in} = 5V$
C_o	Outputs		20 pf	$f = 1 \text{ MHz}, V_{in} = 5V$

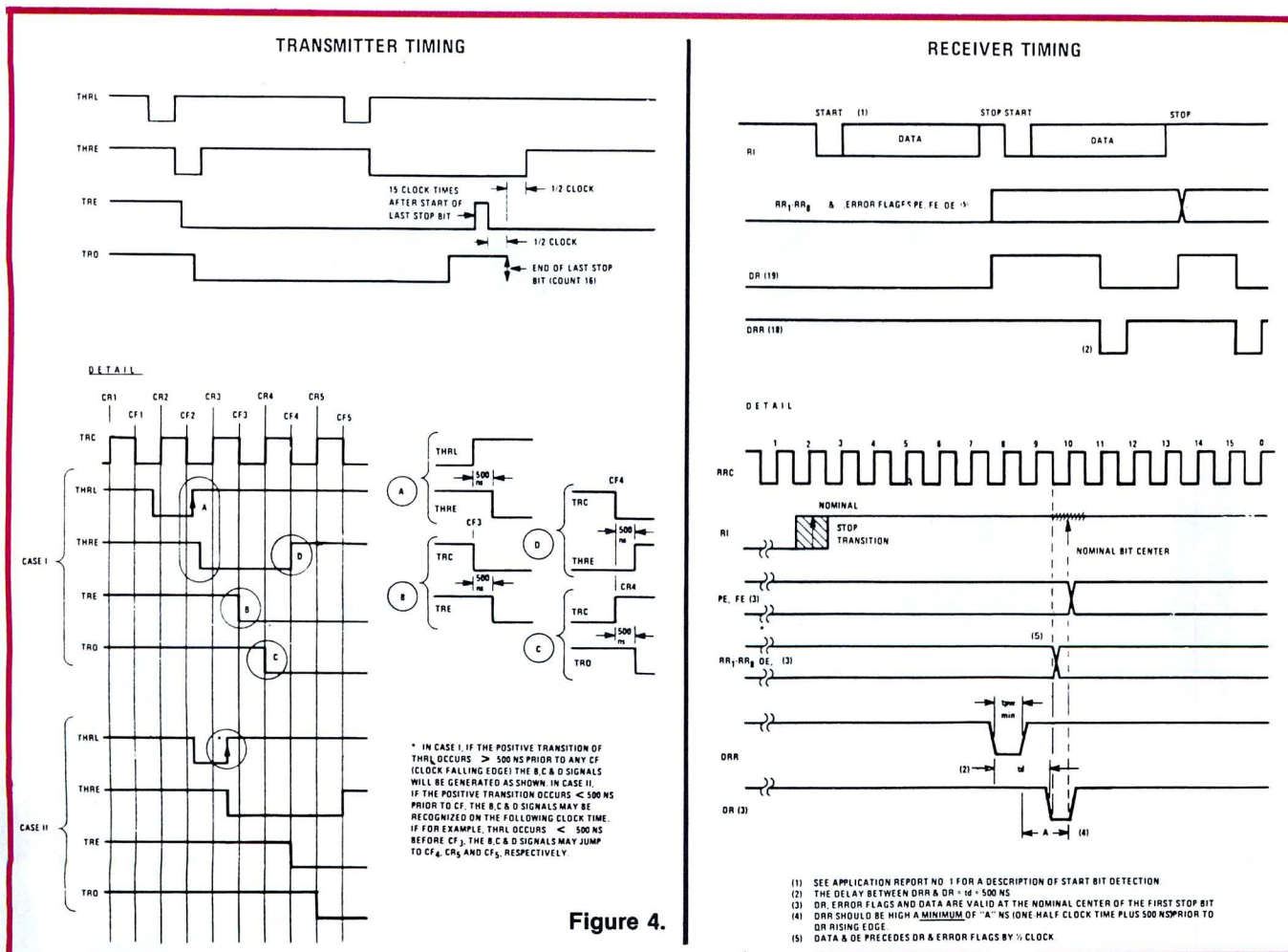
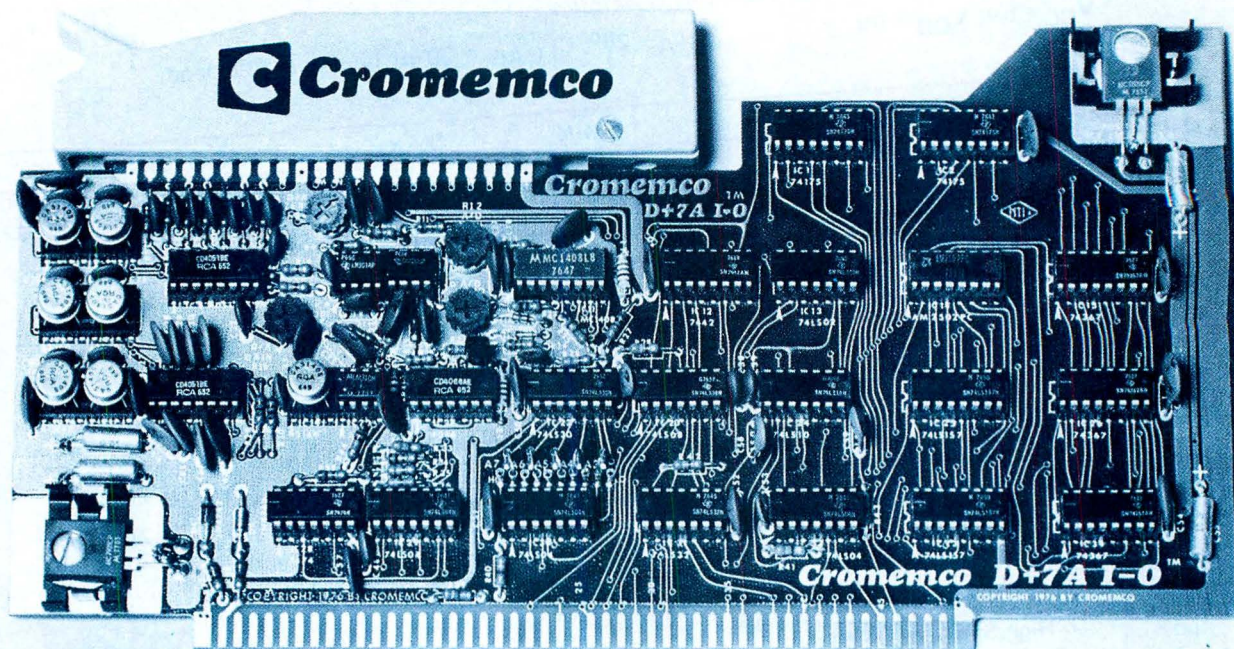
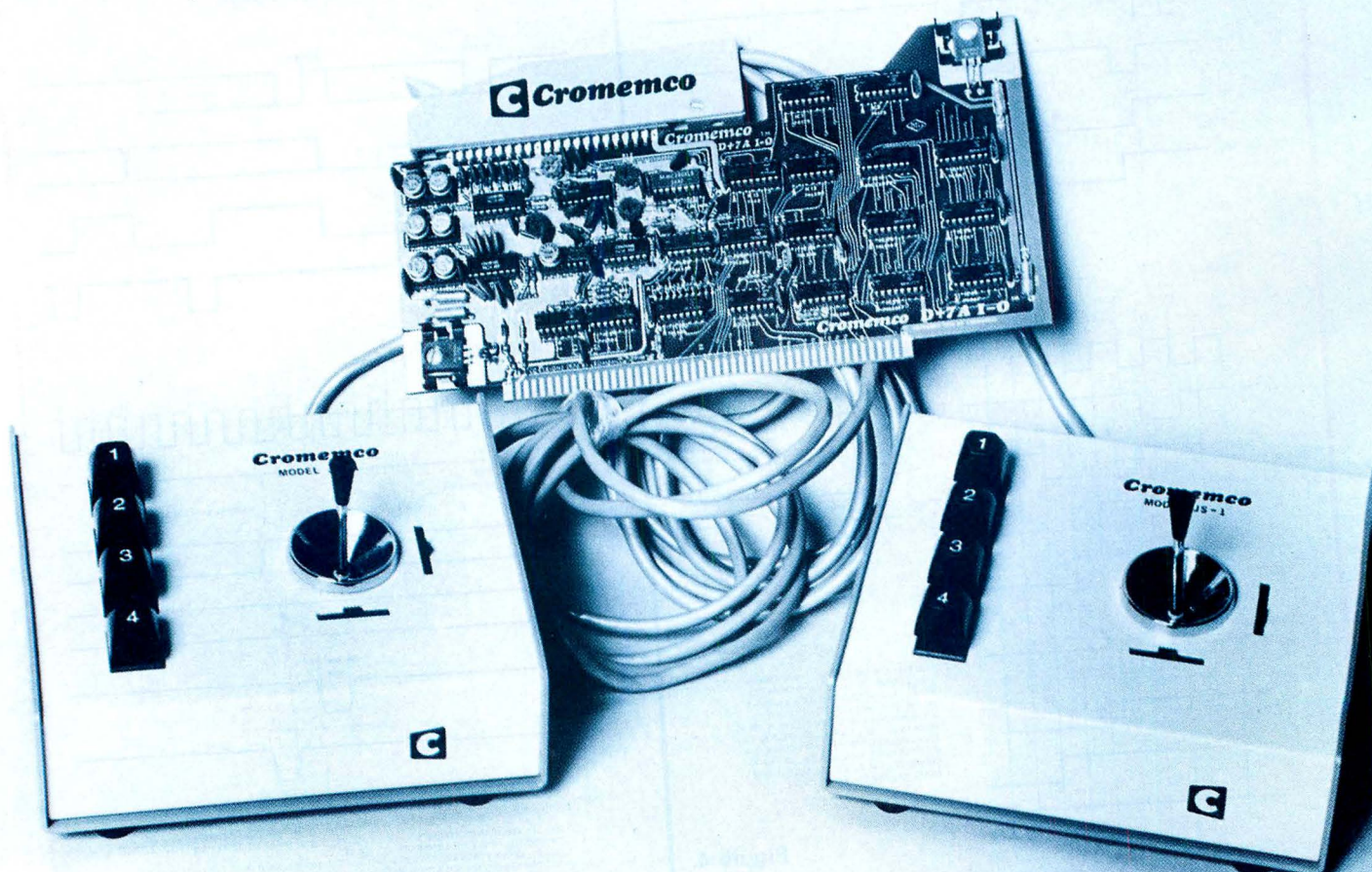
* f_{max} for TR1863A or B 1.0 MHz

Figure 4.



Cromemco D+7A I/O is a card which features one digital and seven analog input/output ports.

The D+7A I/O card as joystick interface with JS 1 joystick console.



ADD ANALOG CAPABILITY TO YOUR COMPUTER WITH THE CROMEMCO D+7A I/O

by Roger H. Edelson

This month I will report on the Cromemco D+7A I/O card (freely translated that's One Digital Plus Seven Analog Inputs/Outputs) and the associated Joystick Console. The D+7A I/O will be covered first, because without an analog channel you can't make use of the Joystick Console.

The Cromemco D+7A I/O card allows you to input and output analog signals as easily as you would digital ones. One digital and seven analog input/output ports are provided, with five port address jumper wires used to select the starting port address of the board. The lowest port address is the location of the digital I/O port with the next higher seven locations setup for the seven analog I/O ports. Cromemco suggests selection of port 030 (octal) as the digital port with ports 031 through 037 as the seven analog ports.

Let us begin our review of the D+7A I/O board with the single parallel digital I/O channel. Figure 1 provides the schematic diagram of Revision 3 of the board. Quad D flip-flops, Z1 and Z2 (74175's), are used as output latches and drivers. The Quad 2-Line to 1-Line Data Selectors/Multiplexers (Z25 and Z33 — 74LS157's) are used to place the digital word supplied by the computer on the input lines of the Quad D flip-flops. Being very sneaky, Cromemco, which has inverted DO7 (for reasons which will be explained later) has corrected this inversion by using the Q output of Q_A on Z₂ — very tricky. The parallel digital input is buffered by the omnipresent 74367 Hex Buffers (the same animal as the possibly more familiar 8T97 series Hex Buffers). Input STB is used to strobe these buffers and is generated by Z12 (a 7442 BCD/Decimal Decoder). This strobe is produced by a Port 0 Input command — that's port 030 if you have used the suggested port locations given by Cromemco. The strobe (or clock) to the digital output latches is generated by a port 0 output command. The digital channel is really nothing special, and only accounts for a small slice of the board space, but it does provide a convenient means of getting a digital word in and out of the computer. The real heart of this card is the seven analog input/output channels.

The Cromemco D+7A I/O board provides seven multiplexed channels of analog input/output including conversion to and from digital words. The analog-to-digital (A-to-D) conversion is performed by a successive approximation technique. As implemented in the D+7A I/O card an 8-bit multiplying digital-to-analog converter (MC 1408L-8) and an 8-bit successive approximation register (SAR) are used to provide an approximately $\pm 0.5\%$ D-to-A/A-to-D converter.

Let's follow the functional operation of the analog/digital conversion section, beginning with the analog output cycle, because it is the easiest.

Stripped to its basics, the digital-to-analog output conversion consists of applying eight bits of digital data to the input of the MC1408L-8 D-to-A converter. This produces a current of between 0 and 2ma. (depending on the value of the digital word) into pin 4. A balancing current, equal to $\frac{1}{2}$ of the full-scale chip current) is sup-

plied by the A/D zero network to provide a zero-set and bi-polar operation. The result of these currents operating on resistor R₁₈ is to produce a voltage in the range of ± 2.56 volts to be applied to the analog output hold circuitry. These circuits are simply an operational amplifier connected as a voltage follower with a voltage holding capacitor on the input. An RCA 3140 BiMOS operational amplifier is used for this circuit to provide the characteristics needed for good operation. The 3140 device combines a MOS/FET input with a bipolar output (hence the name) to achieve low input currents with a high output drive capability. The typical electrical characteristics of the RCA 3140 are shown in Table 1. With ± 5 volt supplies the input current should run around 22 amp. Using a 0.0022 μ fd. holding capacitor, the analog output droop caused by this current is given by $V/t = I/C$. Using the values provided this gives $22 \times 10^{-12} / 0.0022 \times 10^{-6}$, or approximately 10 mv per second droop because of the amplifier (a $\frac{1}{2}$ -bit or approximately .1% FS error in one second). Additional components of output droop are caused by output leakage current of the multiplexer switch and the capacitor and board leakages. While on the subject of the holding capacitor, the manual and the schematic both indicate that these components should be mylar. This is required both for leakage considerations and to minimize errors caused by dielectric relaxation. Unfortunately the capacitors supplied with my kit look suspiciously like ceramic types — a no-no. Cromemco does not provide a specification for analog output accuracy nor droop, other than to indicate that the refresh rate should be 1 Hz or faster.

Table 1.
TYPICAL ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS V ⁺ = +15V V ⁻ = -15V T _A = 25°C	LIMITS			UNITS
		CA3140B	CA3140A	CA3140	
Input Offset Voltage Adjustment Resistor	Typ. Value of Resistor Between Term. 4 and 5 or 4 and 1 to Adjust Max. V _{IO}	43	18	4.7	k Ω
Input Resistance R _i		1.5	1.5	1.5	T Ω
Input Capacitance C _i		4	4	4	pF
Output Resistance R _o		60	60	60	Ω
Equivalent Wideband Input Noise Voltage e _n	BW = 140 kHz R _S = 1 M Ω	48	48	48	μ V
Equivalent Input Noise Voltage e _n	f = 1 kHz R _S = 10 kHz 100 Ω	40 12	40 12	40 12	nV/ Hz
Short Circuit Current to Opposite Supply Source I _{OM} + Sink I _{OM} -		40 18	40 18	40 18	mA
Gain Bandwidth Product f _T		4.5	4.5	4.5	MHz
Slew Rate SR		9	9	9	V/ μ s
Sink Current From Terminal 8 To Terminal 4 to Swing Output Low		220	220	220	μ A
Transient Response: Rise Time Overshoot t _r	R _L = 2 k Ω C _L = 100pF	0.08 10	0.08 10	0.08 10	μ s %
Settling Time t _s	1 mV at 10 V p-p (See Fig. 17) 10 mV	4.5 1.4	4.5 1.4	4.5 1.4	μ s

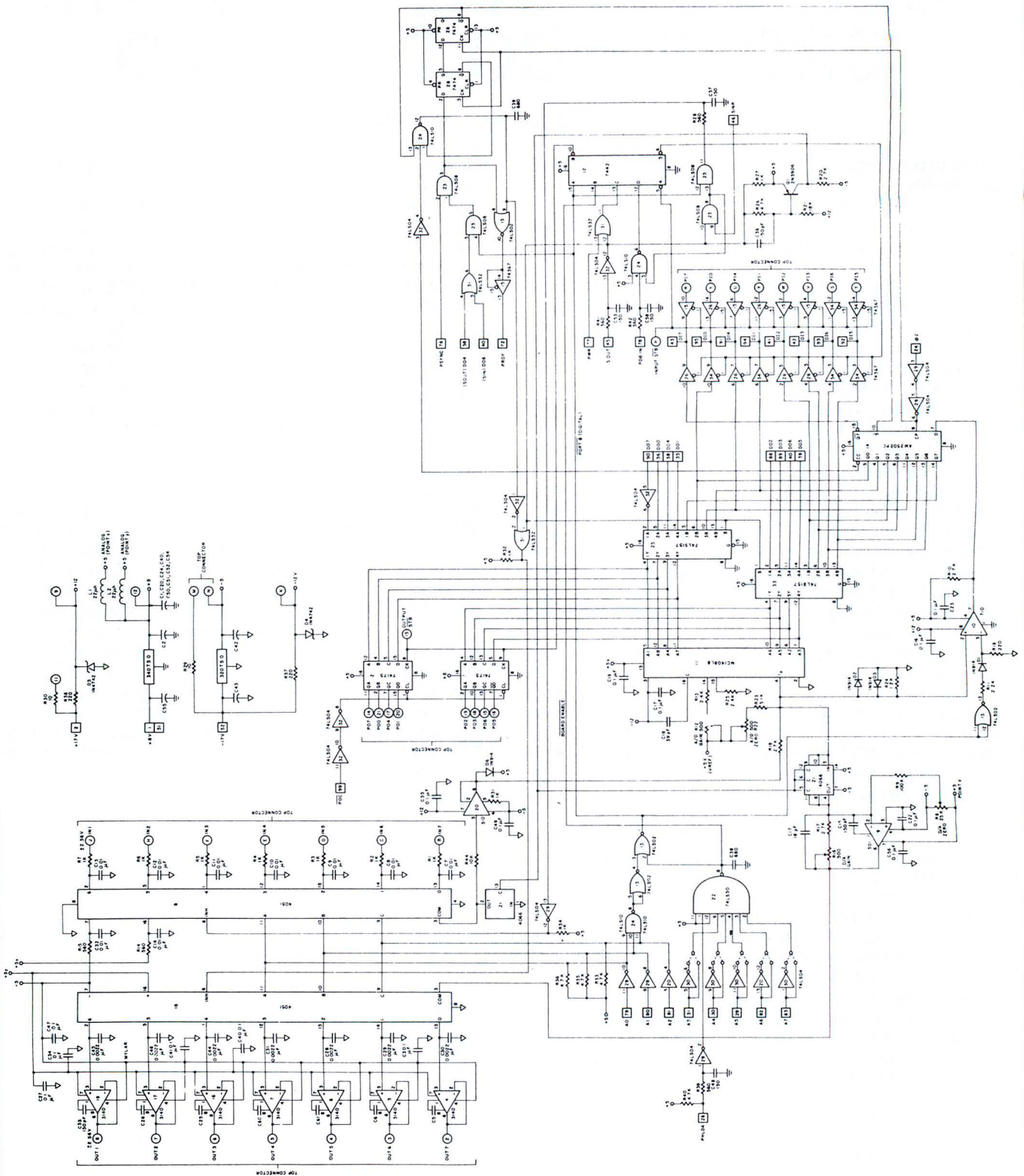


Figure 1. Cromemco D+ 7A I/O™ Schematic

The drive capability of the analog output is about 30 ma source and a 12ma sink; adequate enough for most applications. Again, Cromemco does not provide a specification for this function, I determined the value from the characteristics of the RCA 3140. The slew rate of the 3140 is fast enough ($9 \text{ V}/\mu\text{sec.}$) but its settling time is $4.5\mu\text{sec.}$ for a 1 mv. error. For this reason, 11 wait states ($5.5\mu\text{sec.}$) have been provided before allowing another command to be performed.

The actual operational cycle of the analog output begins when the CPU sends PSYNC and SOUT at the start of an analog output cycle in coincidence with a port address in the range 31 to 37, Z28 P5 goes high to indicate this event. Gating logic then causes PRDY to be pulled to a logic 0, causing the CPU to enter a wait state. One 02 cycle later, Z28 P8 goes low instructing the successive approximation register (SAR) to begin operation on the next 02 rising edge. The SAR then begins operation and holds down its CC output for an additional 8 02 cycles. During analog output, the SAR is used only as a timing device to generate a sufficient number of wait states to cause proper circuit operation. Its other outputs are ignored. The logic gating holds down PRDY until the SAR has completed operation and released its CC output. A total of $5.5\mu\text{sec.}$ of wait states are produced at 2MHz.

As a result of SOUT going to a logic 1, Z32 P12 goes to a logic 0. This signal switches most of the circuitry between input and output modes. In particular, pin 1 of Z25 and Z33 go low, selecting the A inputs, and Q1 produces +5V at the control inputs of Z21, turning its sections ON.

With Z25 and Z33 switched to their A inputs, the 8 data bits flow from the DO bus to the inputs of the D/A converter Z11. This causes a current to be pulled by the I/O output, pin 4, towards the -12V supply, with its magnitude proportional to the binary number at its inputs A1-A8. Resistors R12 and R13 provide the full scale reference current for the D-to-A converter, while R22 and R23 produce a half scale offset so that the code 10000000 at the D-to-A converter input produces 0 volts output. Inverter Z32 complements DO7 so that 0 volts output occurs for the code 00000000 on the DO bus, thereby giving 2's complement operation. This allows bipolar operation of the D-to-A converter with binary numbers the CPU can generate. Now we see the reason for inverting 007.

Since the CMOS transmission gate Z1 is ON, a resistance of about 30 ohms connects the D/A converter output to pin 2 of Z9. This amplifier then produces whatever voltage is needed at its pin 6 (in the range ± 2.56) so that the current through R16 and R17 exactly balances the D-to-A converter output current. The output voltage at Z9 P6 then goes to the output S/H multiplexer Z18 P3. The output port address bits A0-A2 direct the multiplexer Z18 to connect Z9 P6 to one of the .0022 voltage hold capacitors with a CMOS transmission gate. Current then flows to charge the selected holding capacitor to the desired output voltage. Charging is enabled only during the wait states of an analog output function. Voltage follower amplifiers with MOS inputs copy the holding capacitor voltages to the analog output pins, thereby preventing drift due to loading.

The analog input uses a successive approximation A-to-D conversion technique. Figure 2 provides a functional block diagram of this type of converter. The comparator is used as the decision element to control the state of the eight bits of the successive approximation register. When the conversion cycle starts, the SAR first sets its Q7 output to a logic 0 and outputs Q0 through Q6 to a logic 1. This causes the D-to-A to sink a current equal to one-half the full scale value of approximately 2mA. At the end of the first clock period, the SAR

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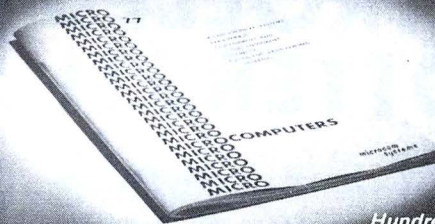
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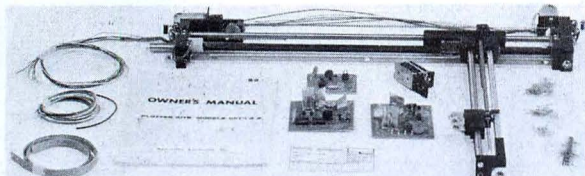


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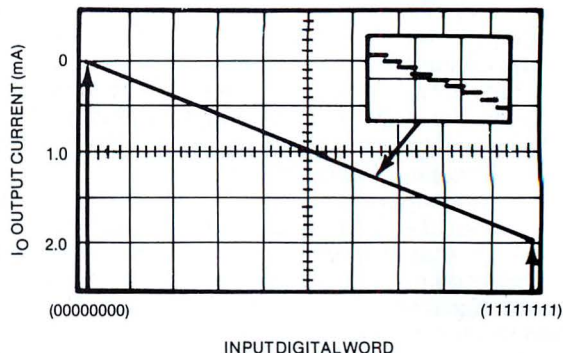


Figure 2.

checks the output of the comparator Z10. If the analog input voltage is negative, the SAR leaves bit Q7 clear. Otherwise, it is set. At the same time, the SAR also sets Q6 to a logic 0. It then waits one clock cycle before using the comparator output to set the state of Q6, and clears Q5. In a similar manner, the successive approximation procedure continues until all bits Q0-Q7 have been set and subsequently tested. This procedure corresponds to the use of a set of 2 pan balance scales with binary weight values to weigh an object, and is the fastest procedure operating on only one bit at a time. Other procedures are available which operate on more than one bit at a time, at the expense of circuit complexity, and dual slope A-to-D converters will provide more accuracy at the expense of time. The successive approximation technique is a good trade-off between circuit complexity and conversion time. At the end of the conversion cycle the SAR outputs contain the digital representation of the analog voltage.

The heart of this A-to-D converter is the Motorola MC1408L-8 Eight Bit Multiplying Digital-To-Analog converter. Figure 3 provides a look at the block diagram of the MC1408L-8 and the D-to-A Transfer Characteristics. As can be seen from Table 2 (the electrical characteristics of the chip) this device provides a $\pm 0.19\%$ relative accuracy (to full scale). This accuracy is degraded by the scaling circuitry used on the board. Again, Cromemco does not provide an accuracy specification. The MC1408L-8 possesses a very fast settling time (300nsec to within $\frac{1}{2}$ LSB). This allows a bit to be set every clock period, at a 2 MHz clock rate.

BLOCK DIAGRAM

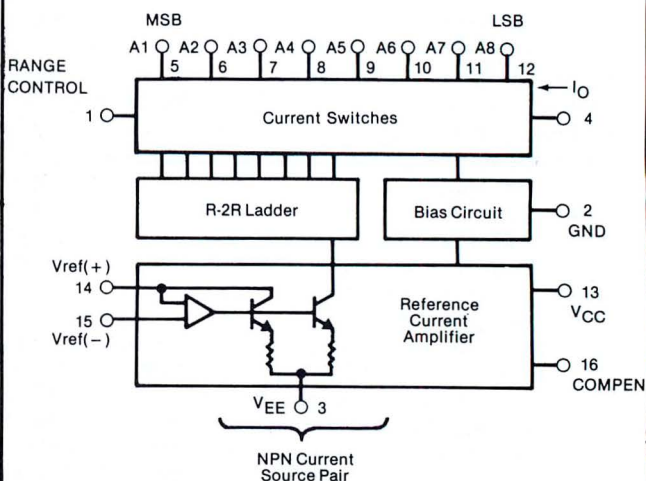


Figure 3.

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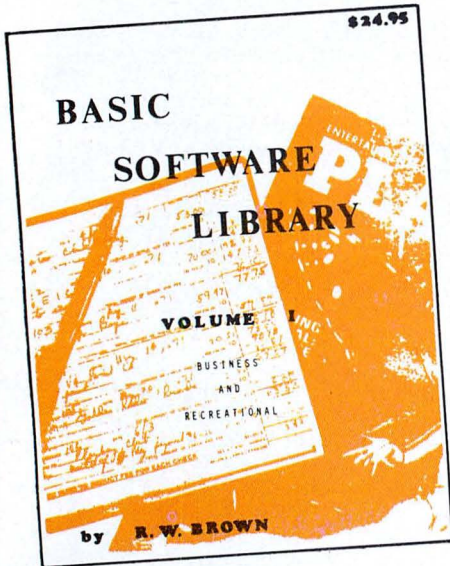
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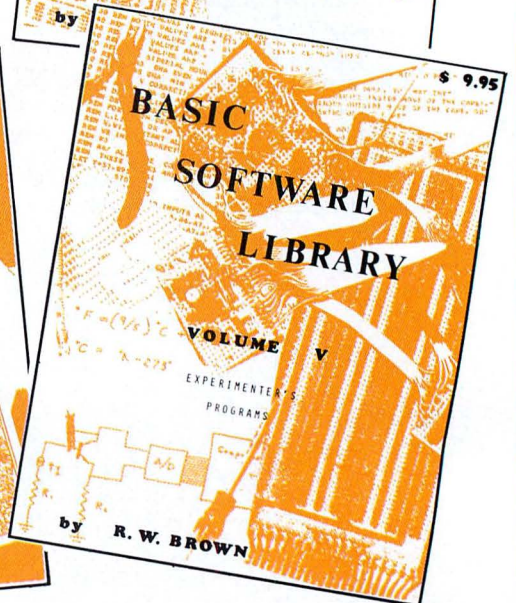
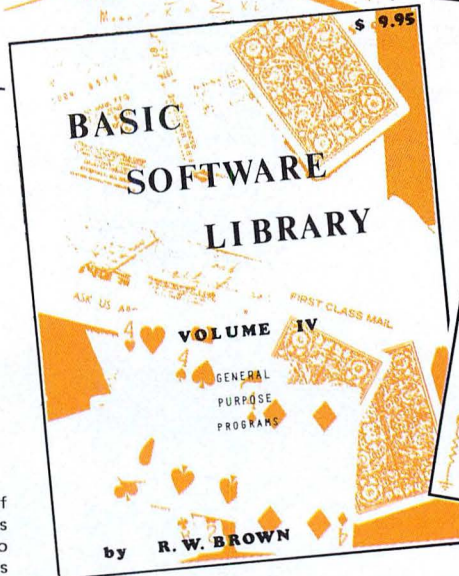
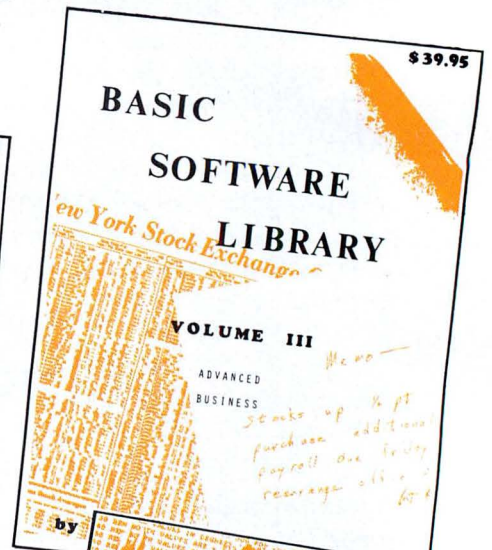
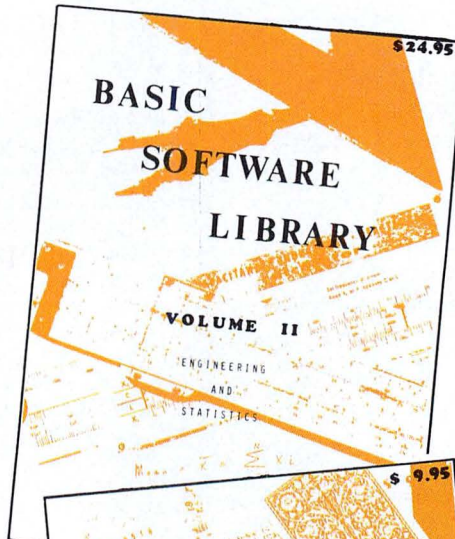
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The MC1408L-8 consists of a reference current amplifier, an R-2R ladder network, and eight high-speed current switches. To use the device all that is necessary is to supply a reference voltage to pin 14 (done from +5X through the A/D gain network) and a reference resistor (R25) to pin 15. The switches are non-inverting, therefore a high state on the digital input line turns them on. High speed current steering switches are used in the selection of the current specified by the R-2R ladder. This ladder divides the reference amplifier current into binary-related components which are fed to the switches.

Let's take a look at the analog input cycle. At the start of the cycle the CPU sends PSYNC and SINP in coincidence with an analog port address. Z28 detects this event and initiates a cycle in a manner similar to the analog output sequence. In this case, however, the SAR output is connected by the multiplexers Z25 and Z33 to the D-to-A converter's data inputs.

The input port command for channels 1 to 7 is taken from A0 through A2 by the analog multiplexer Z8 and used to connect an analog input to the voltage follower Z20. In this case, Z21 is an open circuit. Voltage follower Z20 has a very low input current requirement in combination with a fast slewing capability. This prevents loading of the signal sources and allows full accuracy for source impedances of up to 10K ohms. Output from the voltage follower goes through R18 to inject current into the summing node at Z11 P4 and Z10 P2. After the 2-clock cycle time delay generated by Z28 to allow for settling of the input circuit, the SAR begins the conversion process which we have already discussed. At the end of the conversion cycle, the SAR outputs

contain the desired data word. The CC output goes to a logic 0, signalling the end of the conversion process and allowing the CPU to proceed. The CPU then inputs Q0 through Q7 as its data. Q7 is complemented to produce a 2's complement binary code and allow straightforward bipolar operation.

Let's now take a look at the D + 7A I/O mechanized as a kit. The card is of the same high quality material and construction as I have come to expect from the Cromemco kits. The board is high quality glass with all the etch tinned. The edge board connectors are gold plated for reliability. The solder masking and the component marking are excellent. The solder masking in particular is detailed enough to prevent many of the easily-made solder splash problems. The board in places looks unfortunately as if it were laid out by an engineer. This does not affect operation, and is probably necessary to assure good noise characteristics and reliable operation, but it is esthetically somewhat unappealing.

Construction is straightforward requiring only about 2½ hours from unpacking to board cleaning, a step which Cromemco fails to mention — but is extremely important in any analog board. Some small problems showed up during assembly:

1) Some of the IC's should be temporarily inserted when installing the 0.0022 μ fd. capacitors, particularly IC 18. This must be done or you will find it very difficult to get the IC inserted after the capacitors have been soldered in place. IC's 23 and 34 are also tight because of the two capacitors C38 and C39. Resistor R13 must be inserted before the potentiometer R12.

2) The board pads are not always correctly spaced,

Table II.

ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN

At $V^+ = 15V$, $V^- = 15V$, $T_A = 25^\circ C$ Unless Otherwise Specified

CHARACTERISTIC	LIMITS									UNITS
	CA3140			CA3140			CA3140			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage, $|V_{IO}|$	—	0.8	2	—	2	5	—	5	15	mV
Input Offset Current, $|I_{IO}|$	—	0.5	10	—	0.5	20	—	0.5	30	pA
Input Current, I_I	—	10	30	—	10	40	—	10	50	pA
Large-Signal Voltage Gain, A_{OL}^{\bullet}	50 k 94	100 k 100	— —	20 k 86	100 k 100	— —	20 k 86	100 k 100	— —	V/V dB
Common-Mode Rejection Ratio, CMRR	— 86	20 94	50 —	— 70	32 90	320 —	— 70	32 90	320 —	μ V/V dB
Common-Mode Input-Voltage Range, V_{ICR}	— 15	— 15.5 to + 12.5	12	— 15	— 15.5 to + 12.5	12	— 15	— 15.5 to + 12.5	11	V
Power-Supply Rejection $\Delta V_{IO}/\Delta V$ Ratio, PSRR	— 80	32 90	100 —	— 76	100 80	150 —	— 76	100 80	150 —	μ V/V dB
Max. Output Voltage V_{OM}^{+} V_{OM}^{-}	+ 12 — 14	13 — 14.4	— —	+ 12 — 14	13 — 14.4	— —	+ 12 — 14	13 — 14.4	— —	V
Supply Current, I^{+}	—	4	6	—	4	6	—	4	6	mA
Device Dissipation, P_D	—	120	180	—	120	180	—	120	180	mW
Input Current, I_I^{Δ}	—	10	30	—	10	—	—	10	—	nA
Input Offset Voltage V_{IO}^{Δ}	—	1.3	3	—	3	—	—	10	—	mV
Large-Signal Voltage Gain, A_{OL}^{Δ}	20 k 86	100 k 100	— —	— —	100 k 100	— —	— —	100 k 100	— —	V/V dB
Max. Output Voltage, V_{OM}^{+} V_{OM}^{-}	+ 19 — 21	+ 19.5 — 21.4	— —	— —	— —	— —	— —	— —	— —	V
Large-Signal Voltage Gain, $A_{OL}^{\dagger\star}$	20 k 86	50 k 94	— —	— —	— —	— —	— —	— —	— —	V/V dB

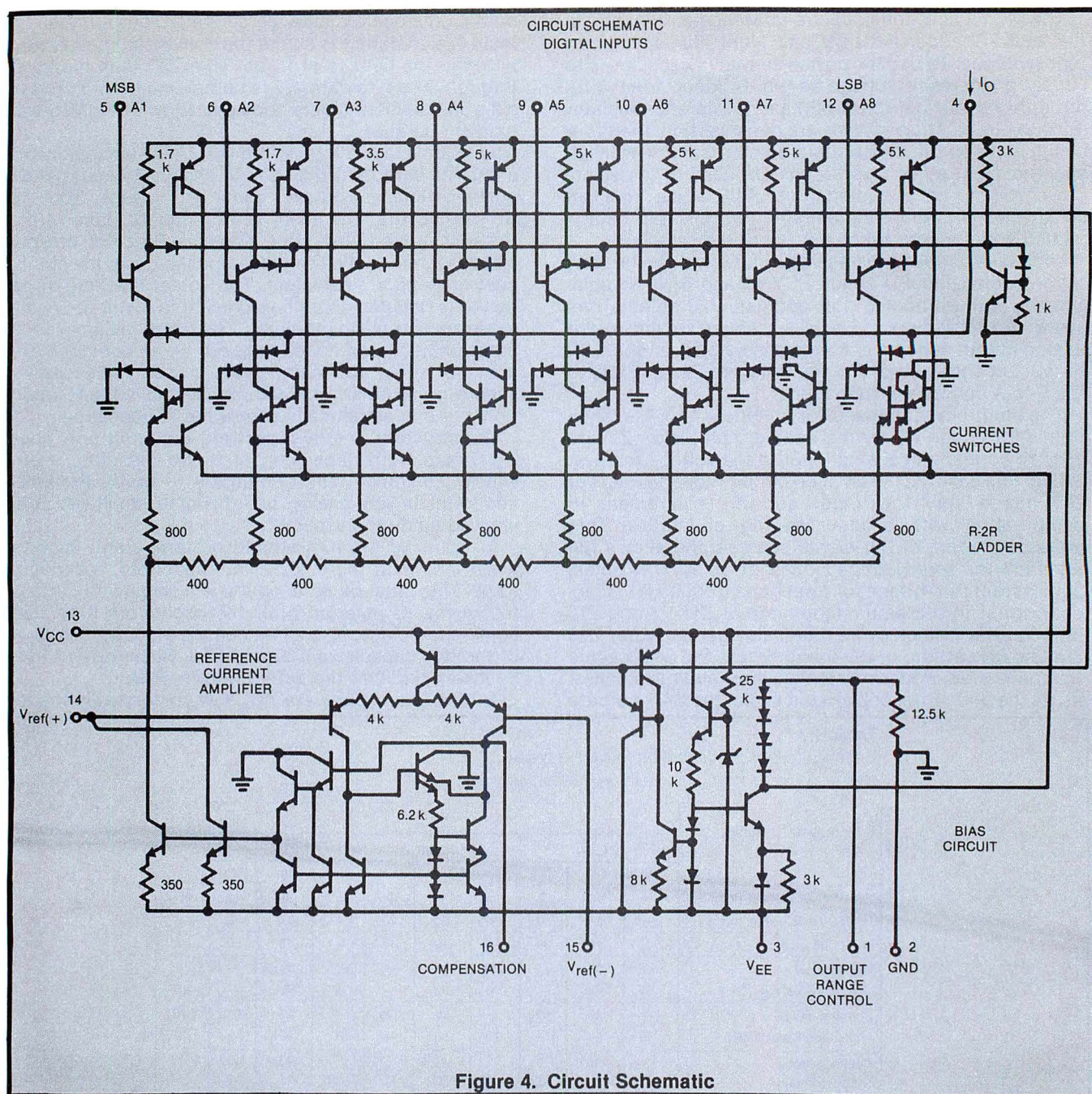
$^\bullet$ At $V_O = 26V_{p-p}$, + 12V, — 14V and $R_L = 2k\Omega$.

$^\Delta$ At $R_L = 2k\Omega$.

$^\Delta$ At $T_A = -55^\circ C$ to $\pm 125^\circ C$, $V^+ = 15V$, $V^- = 15V$, $V_O = 26V_{p-p}$, $R_L = 2k\Omega$.

* At $V^+ = 22V$, $V^- = 22V$.

† At $V_O = +19V$, — 21V, and $R_L = 2k\Omega$.



for the 0.1 μ f capacitor lead spacing, making it difficult to seal some of these capacitors.

3) No layout drawing is provided. The component marking on the board, as indicated earlier, is excellent making assembly a not difficult task. But I like a layout drawing also — it can't cost that much.

These gripes are really very minor and don't affect the kit in any way. They really don't much slow down construction either.

One nice feature — my CA3140 IC leads were already shaped, which made light work of inserting these devices. Again, though Cromemco doesn't mention it, don't forget to clean the solder resin off your board. This step is a must to reduce the board leakage current and achieve high-quality A-to-D operation.

After assembly of the board it is necessary to calibrate the analog/digital/analog channels. The calibration procedure begins with the A-to-D channel. Known voltages must be applied to the analog input and the A/D gain (R12) and A/D zero (R22) are adjusted until the digital value is correct. While this is straightforward, (even though R12 and R22 interact requiring an iterative

procedure) the instructions require an input of +2.54 v and -2.56 volts — values not likely to be found lying around everyone's computer room. A variable power supply and a digital voltmeter will do the job — if you have one.

A possible alternative would be to set the analog input to 0 volts (short it) and adjust the R22 until the output of the selected digital port is "0". Then apply any known—or measured—voltage (a battery, etc.) and set the A-to-D gain (R12) until the digital value is the representation of the analog voltage supplied (remember, each bit = 20mv). Reversing the battery will provide a negative voltage to check both polarities. It may be necessary to readjust R22 to get the correct negative digital value. Remember, as the D + 7A I/O uses two's complement representation, 10000000 (80_H) is equal to -2.56V and FF_H (11111111) is not "0" but actually -20mv. For this reason the negative full scale value is 20 mv. greater than the positive full scale (bit 8, the sign bit, provides the extra -20mv.). Figure 5 gives an example of some of the 8-bit two's complement representation of analog voltages.

After the analog input channel has been calibrated the analog output is calibrated. An accurate voltmeter is all that is required for this simple operation. Using the program supplied by Cromemco R16 (D-to-A) gain is adjusted for full scale positive output. The program is then modified and the D-to-A zero pot. (R8) is adjusted for a zero output. This procedure may have to be repeated once or twice as these controls interact also.

Besides providing the digital and analog I/O channels at the top edge board connector (gold plated for reliability) Cromemco has also brought out several power supply voltages. Analog and digital grounds are separated to avoid placing digital return currents in the analog ground returns. Figure 6 shows the top connector pin assignments. Cromemco has also thoughtfully provided the female counterpart to the top-edge connector. This connector is equipped with a nice handle for easy insertion and removal.

01111111	+ 2.54 volts
00000001	+ 0.02 volts
00000000	0 volts
11111111	- 0.02 volts
10000000	- 2.56 volts

Figure 5.

The D+7A I/O card is a well-thought-out addition to your computer, which will expand the capabilities of your present installation and allow you to handle analog signals as easily as digital. Some of the more popular applications for this card would be oscilloscope graphics, process control, music or voice synthesis, and joystick interfaces. In line with the last mentioned application, Cromemco provides a Joystick Console (JS-1) which is set up to interface with the D+7A I/O card.

As can be seen in the schematic, the JS-1 provides four switches as digital inputs, two pots (with mechanical trim adjustments) arranged as a two-axis joystick as analog inputs, and an emitter follower driving a 45-ohm speaker as one analog output. The digital switches operate to provide +5 volt in their open condition and ground in the energized state. The emitter follower is AC coupled with a time constant of about 50msec.

Construction is extremely easy. However, I don't much care for unsupported components. I wish Cromemco had provided a standoff for the 10K resistors. Initial checkout is also a snap. The instructions are more than adequate.

With the JS-1 Cromemco also provides the software for Dazzle-Doodle™, a program which is designed to allow the user to draw full-color pictures on the screen of an ordinary TV under joystick control. The hardware required is a D+7A I/O to interface the joystick, and a Cromemco TV Dazzler™ for the TV display interface. The computer must supply 2K of static RAM for picture element storage, and another approximately 128 bytes of program storage.

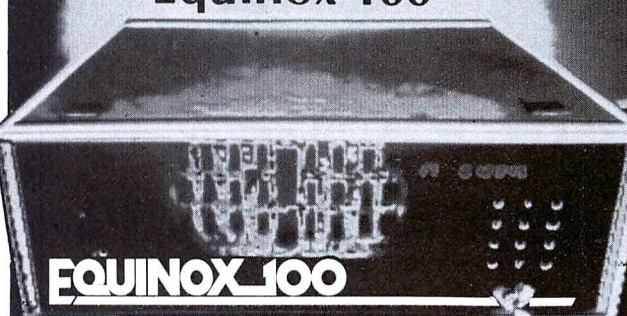
Cromemco also provides software support for the joystick console including Dazzle-Doodle, Track, Chase!, and Spacewar, complete with documentation. Each of these games is available on paper tape with the documentation for \$15 a piece.

The JS-1 provides an easy and lowcost way to provide an analog input to your D+7A I/O card. When these two units are combined, it is easier to enter analog inputs into your computer than digital — and in some cases more fun.

CONNECTOR PIN ASSIGNMENTS			
COMPONENT SIDE	PIN No.	PIN No.	SOLDER SIDE
ANALOG GROUND	A	1	ANALOG GROUND
ANALOG INPUT	7 B	2	ANALOG OUTPUT
	6 C	3	
	5 D	4	
	4 E	5	
	3 F	6	
	2 H	7	
ANALOG INPUT	1 J	8	ANALOG OUTPUT
-12V REGULATED	K	9	+12V REGULATED
ANALOG GROUND	L	10	ANALOG GROUND
-17V UNREGULATED	M	11	+17V UNREGULATED
-5V REGULATED	N	12	+5V REGULATED
INPUT STB	P	13	OUTPUT STB
PARALLEL INPUT BIT 7	R	14	PARALLEL OUTPUT BIT 7
	6 S	15	
	5 T	16	
	4 U	17	
	3 V	18	
	2 W	19	
	1 X	20	
PARALLEL INPUT BIT 0	Y	21	PARALLEL OUTPUT BIT 0
DIGITAL GROUND	Z	22	DIGITAL GROUND

Figure 6.



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CIRCLE INQUIRY NO. 38

The Cromemco JS-1 joystick console is a general purpose I/O device designed specifically for use with mini and micro-computers. A Cromemco D + 7A analog interface can be used to interface one of two JS-1 consoles to any computer using the S-100 Microcomputer Bus.

Each joystick console includes a two-axis joystick, four push button switches, and an audio amplifier and speaker in an attractive, finished enclosure. A 12-conductor cable is included to connect the console to the top edge connector of the D + 7A interface.

When using one JS-1 console with the D + 7A interface Cromemco recommends the following port assignments:

- Joystick X axis — analog input port 031 (19H)
- Joystick Y axis — analog input port 032 (1AH)
- SW1 — D0 input port 030 (18H)
- SW2 — D1 input port 030 (18H)
- SW3 — D2 input port 030 (18H)
- SW4 — D3 input port 030 (18H)
- Speaker — analog output port 031 (19H)

When using two JS-1 consoles the following port assignments for the second console are recommended:

- Joystick X axis — analog input port 033 (1BH)
- Joystick Y axis — analog input port 034 (1CH)
- SW1 — D4 input port 030 (18H)
- SW2 — D5 input port 030 (18H)
- SW3 — D6 input port 030 (18H)
- SW4 — D7 input port 030 (18H)
- Speaker — analog output port 033 (1BH)

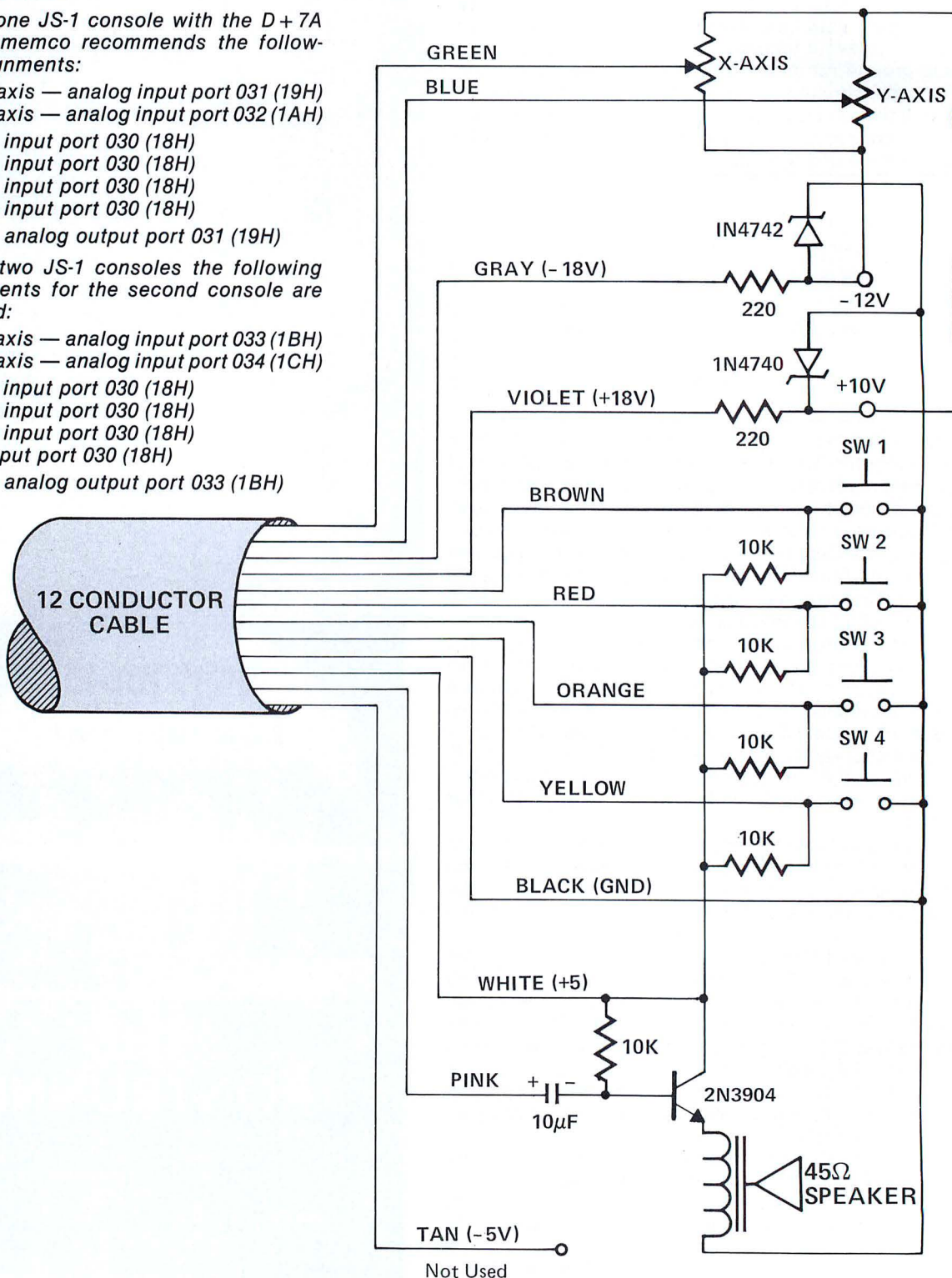


Figure 7. The Schematic Diagram of the JS-1

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PROJECT ENCLOSURES FROM P.C. BOARD

by Tom Balph and Dick Spurgeon

Enclosures for electronic projects are sometimes hard to obtain. Commercially available types may be not just the right size or shape, too expensive, or not in stock. Also, the designer might want to add flair to the project by styling his own enclosure. For such situations, an inexpensive box of professional appearance can be built from standard printed circuit board. An example is shown in photos 1a and b. The enclosure features a black semi-glossy finish with easily read white lettering.

Construction material is 0.60 fiberglass epoxy P.C. board with one side two ounce copper. The copper side of the board always faces the box interior for soldering purposes. *The copper can also be used for power supply distribution if desired.*

Construction begins by planning the size and shape of the project and making a corresponding drawing. Individual pieces of P.C. board are soldered together to form the box, and each piece should be illustrated with corresponding dimensions, holes, and openings. Be sure that parts overlap properly for your design.

Each piece is then cut to size from the drawing. A drop shear is an excellent tool for this or a hand sheet metal nibbler may also be used. Holes and openings are next cut with electric drill, hand punch or hand nibbler. All pieces should then be ready for assembly.

Pieces are soldered together on the *inside* seams where two sides touch (Figure 2). Build up the solder at the seams to form a strong joint. A large chisel point 50 watt iron works well for this. A simple wooden holding

frame to "C" clamp pieces in place can simplify assembly.

After all pieces are assembled forming the entire box, the edges of the assembly should be filed and sanded smooth. All sharp points and edges should be rounded. The box is then ready for painting.

Three light coats of Borden's KRYLON ULTRA FLAT BLACK #1602 are recommended. Light coats are used to prevent running and build-up. Best results occur by holding the spray can approximately 18 inches from the box. This gives a very "flat" finish to the paint. This stage of the work must be done in the open air or in well-ventilated quarters. Wear a mask and safety glasses.

Lettering follows painting by applying white dry transfers. These can be obtained from book stores or art supply stores. Positioning of letters, titles, etc. should be planned out before applying the transfers. Also, very lightly penciled guidelines help give a professional appearance.

The final step before mounting the electronics in the enclosure is a protective coating of clear KRYLON CRYSTAL CLEAR #1302. Actually, two or three light spray coats are best. Again, hold the spray can about 18 inches from the box because this gives a non-glare "crinkle" finish. The clear plastic prevents the dry transfers from being damaged and gives a nice finish to the enclosure. Again, this stage must be performed outdoors or under a ventilation fan. Do not take chances. The enclosure is ready for use after the paint fully dries.

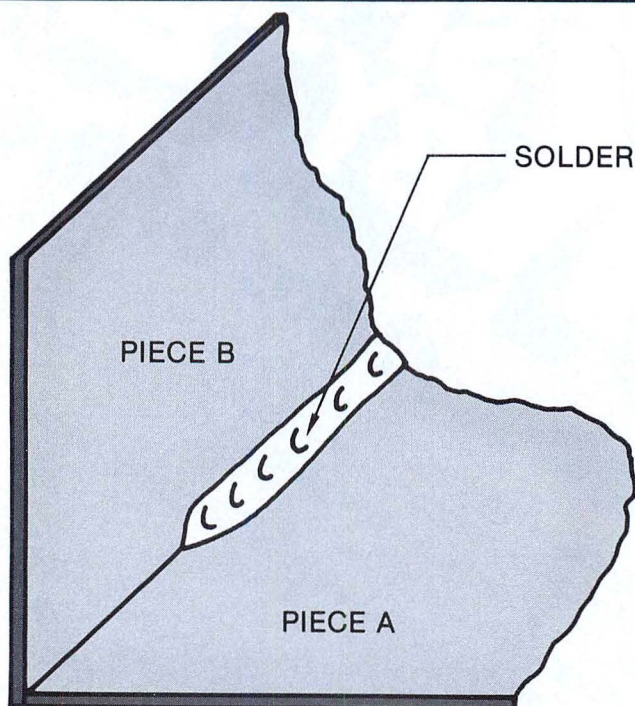
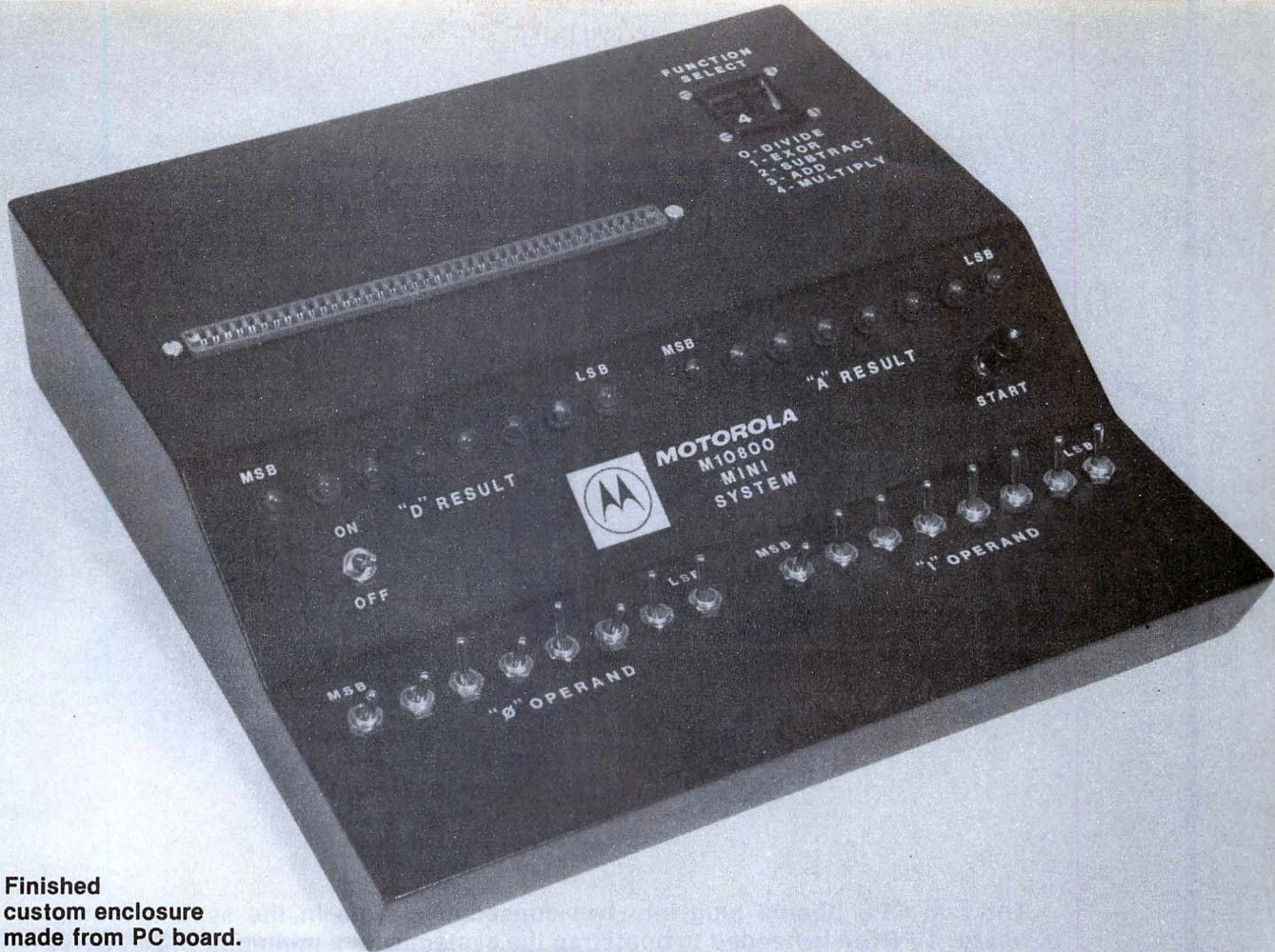
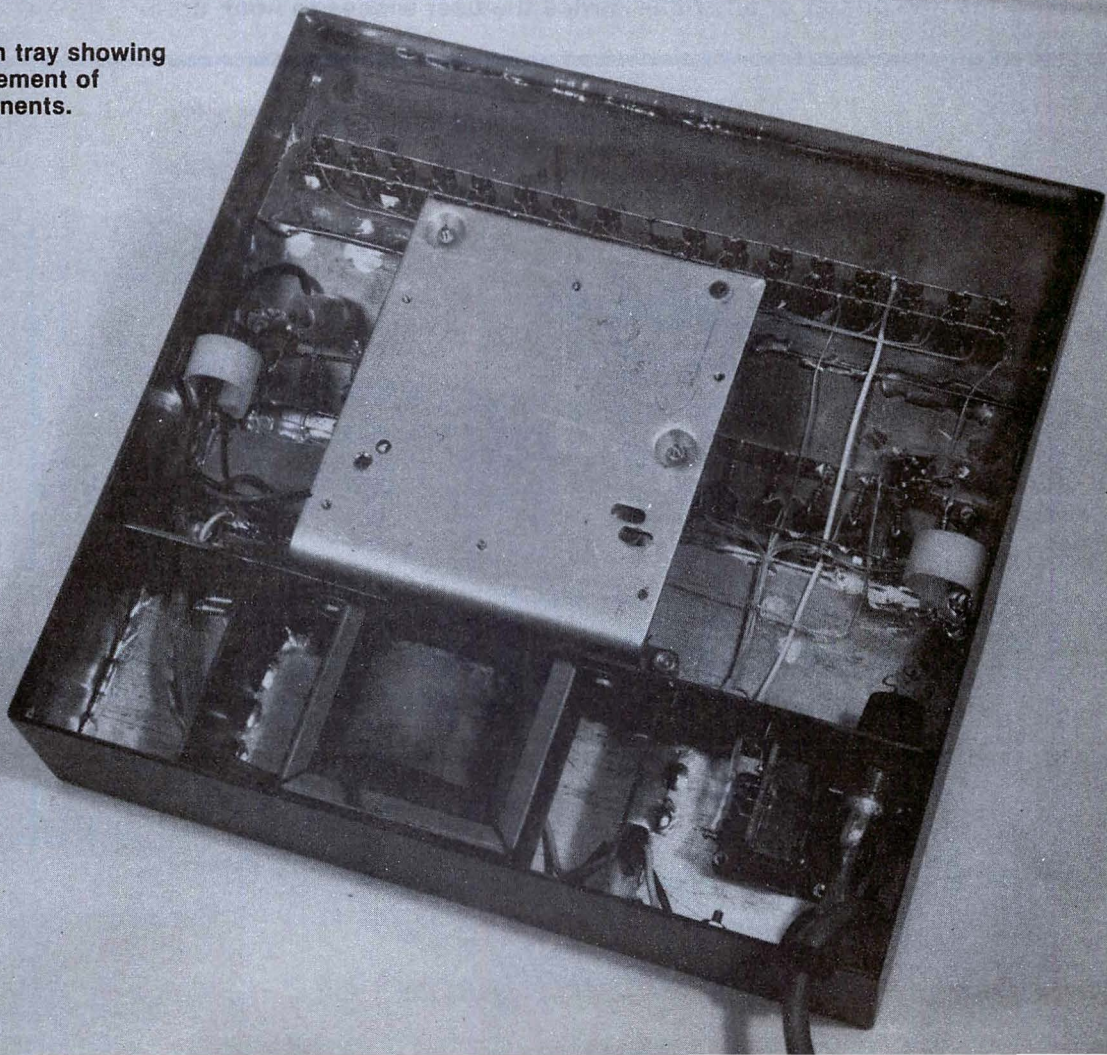


Figure 1. Pieces are soldered on inside seams.



Finished
custom enclosure
made from PC board.

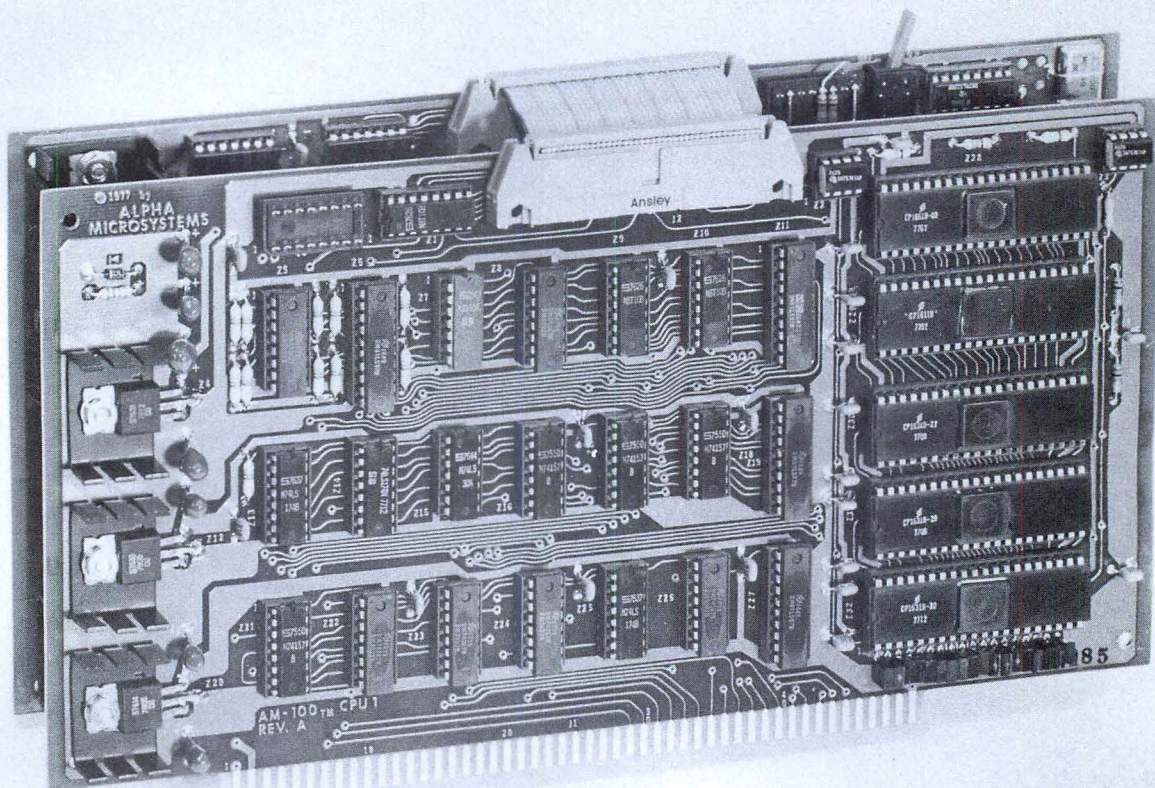
Bottom tray showing
arrangement of
components.





The two CPU boards plug into two consecutive slots in the system mother board. A PROM is needed to bootstrap the system with a minimum of 24K bytes of memory and a 3P + S I/O card for the terminal. The parallel slots are used for the line printer or any other device the user wishes to hook up.

The AM 100™ board in closer view.



A 16-BIT SYSTEM FOR THE S100 BUS THAT HOLDS ITS OWN AGAINST A MINI

by Richard Notari

A 16-bit CPU board set for the 100 bus plugs directly into an IMSAI 8080 or an Altair™ 8800 by means of a 40-pin flat ribbon cable. The two-board set consists of the multiplexer which interfaces the 16-bit bus to the 8-bit S100 bus, the DMA and the *interrupt* logic while the other board contains the 16-bit CPU.

The two CPU boards plug into two consecutive slots in the system mother board. A PROM is needed to bootstrap the system with a minimum of 24K bytes of memory and a 3P+S I/O card for the terminal. The system requires a floppy disc with controller. A video monitor can also be used to give continuous real-time system status.

THE MICROPROGRAMMED CPU

The CPU consists of five 40-pin MOS/LSI chips. This is a reprogrammed version of the Digital Equipment Corporation LSI 11 microprocessor set. It is made by the same company that originally made the LSI 11 microprocessor. The chip set consists of a data chip, a control chip, and three microms. The data chip contains the 26 8-bit file registers and the ALU. It also has the 16-bit data/address (DAL) bus that interfaces the CPU to the outside world. The control chip contains auxiliary DAL bus signals, the four interrupt lines, and a huge programmable translation array (PTA). The microms contain 512 locations of 22-bit ROM memory each. One ROM location contains a 16-bit microinstruction, two control bits, and four auxiliary bits. With the exception of the four auxiliary bits the bus is a high impedance bus. The auxiliary bits, called microm state codes, are TTL level signals that are used to direct the external hardware to perform special functions like: *interrupt enable* and *disable*, external status register input, user bootstrap address input, line clock clear, macroinstruction fetch cycle identification and others. The remaining 18 lines are the microinstruction bus (MIB). It is tied to each of the chips.

The microprocessor is a microprogrammed system that emulates a user-defined macroinstruction set. It is a genuinely microprogrammable CPU. The two busses are totally independent of each other. The user never sees the execution of microcode except when it affects the DAL bus. Macroinstructions are fetched from memory in 16-bit chunks, decoded by the microcode and the PTA, and executed as directed. Most of the microinstruction decoding and execution is done in the data chip in stages with the first breakdown being the major OP-CODE grouping.

Most of the macroinstruction decoding takes place in the control chip PTA. This is followed by source and destination decoding, as needed, and finally terminated by the actual OP-CODE decoding. All of this decoding is done in parallel with microinstruction executions in the data chip. Basically the PTA looks at the current value of the microprogram location counter (LC) and matches it against a table of values. If a match occurs a 7-bit code is generated that represents the subset of the total translation table that is to be checked. The translation table has the 7-bit code as an input along with the contents of either the interrupt register or one half of the

translation register. The interrupt register consists of the four external interrupt lines and three internal bits. These internal bits are used as a *wait* flag, a *trace* flag, and as a translation *disable* to allow for testing of the device. The translation register contains a copy of the macroinstruction currently being executed. If a match occurs on one or more entries of the translation table, a new value for the LC is computed and loaded into the LC. Thus, while a microinstruction is undergoing execution in the data chip, the control chip is figuring out from where the next microinstruction is coming. The parallel decoding feature allows a good microprogrammer to decode portions or all of a macroinstruction with almost no overhead. The resulting string of microinstructions looks like linear code.

**As far as the programmer
is concerned, the
CPU is a 16-bit, not an 8-bit.**

The CPU set contains no I/O microinstructions, and neither does the macro set. The 256 I/O ports on the S-100 bus are mapped by the hardware on the second board to the upper 256 bytes of memory. All external accesses are done through the DAL bus. The DAL bus is a 16-bit, three-state, bi-directional, multiplexed bus. All input/output functions consist of a READ or a WRITE microinstruction followed by an INPUT or OUTPUT instruction. In addition, the INPUT instruction has a flag that allows a *read/modify/write* sequence which is accomplished by following the INPUT instruction with an OUTPUT instruction.

During a READ or WRITE instruction the address is placed on the DAL bus. During the INPUT instruction data is transferred from the DAL bus to the CPU bus. During an OUTPUT instruction data are transferred from the CPU to the DAL bus. A SYNC signal starts the process, and a REPLY is used to inform the CPU that the external hardware is ready for the data transfer. Signals such as DIN, DOUT, IACK, and WB inform the hardware of the nature of the current DAL operation. All are self explanatory except for WB. This is a multiplexed line that will specify READ vs. WRITE during the address cycle, and WORD vs. BYTE during the data cycle of a DAL operation.

THE CPU TO S-100 BUS INTERFACE

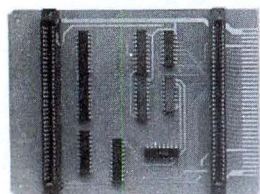
Once the address and data transfer requests are placed on the DAL the bus interface comes into play to latch the address during a READ or WRITE cycle onto the S-100 address bus, and to leave it there as long as SYNC is true. When an INPUT cycle is executed the second board will assemble two bytes of data onto the DAL and send REPLY to the CPU. When an output cycle is executed the multiplexing logic will immediately send a REPLY to the CPU, and latch the data on the boards when they appear. The first byte of data is placed on the bus directly from the CPU, and the second is placed on

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the bus a cycle later. During a word operation the LSB of the address is forced to a zero during the first cycle and a one during the second cycle. The LSB is gated through during a byte or I/O operation. An I/O operation is always a byte operation. In addition, the I/O controller looks at two microm state codes that identify a *read/modify/write* sequence (word and byte), and bypasses the *read* portion of such a sequence. This prevents problems with I/O devices that use the same port for two different functions. It is the only hardware limitation that the programmer needs to keep in mind. All other CPU operations are transparent to the programmer. As far as he is concerned it is a 16-bit CPU, not an 8-bit.

The actual multiplexing is done by a 10-state sequencer. The first state is REST. From there a function called MSYNC is generated. This becomes the sync signal for memory or I/O. States DBIN and #3 are for INPUT functions, once around for a byte operation, and twice around for a word operation. State #4 chains a *read/modify/write* sequence from the INPUT to the OUTPUT sections. States #5 to #7 are for OUTPUT, once around for a byte and twice around for a word. The last two states are HIBYTE and READY. They are used, respectively, for LSB address control and REPLY to the CPU. READY also latches the upper byte of the DAL to the lower byte of the DAL. All transfers from board one to board two are across the upper byte of the DAL. During an I/O or byte operation the same data appears on both bytes of the DAL. The CPU picks off whichever byte it wants according to the value of the address LSB. The CPU is clocked by a 4-phase clock, and phase two is used to clock the multiplexer. Some additional logic is provided for proper I/O and memory signals, but the heart of the matter is the sequencer.

DMA AND INTERRUPT OPERATIONS

The boards provide the user with eight levels of DMA and eight levels of interrupt capability. Level 7 of the DMA logic is hard-wired to PHOLD. This is the method used to select processors. Since the inputs to the DMA priority encoder are inverted signals, an active PHOLD turns on the 16-bit CPU and places the 8080 CPU in a high impedance state. With PHOLD low the DMA logic places the 16-bit CPU in a permanently busy state with all signals at a high impedance state. PHOLD low also turns on the 8080 CPU. A switch is provided to swap processors. A jumper-enabled circuit provides 8080 clocks to the bus if the 8080 CPU is not in the system.

Since PHOLD is now used to select processors, other DMA lines have to be assigned. Eight lines are shared between the DMA and interrupt priority encoders. Interrupt level #7 is not shared since the corresponding DMA level is occupied by PHOLD. The other seven levels are jumper-selectable. Selecting a DMA level or an interrupt level also places a pull-up resistor on the selected line. Eight other lines are provided in a similar manner for DMA grants. In addition, a high level DMAG signal appears one cycle before the actual grant to signal all DMA boards that a new DMA grant is about to be issued. No DMA device should issue a DMA request during the time DMAG is high.

Although only eight lines are provided, and they are shared by both the DMA and interrupt priority encodes, each line could be daisy-chained for an almost infinite number of DMA devices or interrupts. The user would then have a priority matrix for either DMA requests or interrupt requests or both. In addition, there are sockets and platforms that allow the user to select any bootstrap address in the range C000 to FE00, modulo 256; any of the four power up or halt options; external line clock input; and a halt switch.

The system is a development of Alpha Microsystems, 17875 Sky Park North, Irvine, California 92714.

Computer Mainframe System

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Edge connectors

High quality edge connectors factory mounted and wave soldered to eliminate this nuisance for you. Completely checked out for shorts or open traces. ALL edge connectors furnished, 12 for the MCS-112 and 22 for the MCS-122. No additional expense when you expand your system.

The power supply

One of a kind . . . using a constant voltage transformer (CVT) with a very high immunity to input line noise . . . greater than 100 db rejection. Line regulation better than $\pm 1\%$ from an input of 95 to 140 Volt AC at full load to 85 to 140 Volt AC at three quarter load. Designed to meet UL-478 specifications (EDP SPECS). Individual fusing on all input and output voltage lines. See specifications below for power ratings.

The cooling system

A 115 CFM muffin fan with a commercial grade washable filter will provide clean airflow over all circuitry.

The wiring

All wiring is color coded and ALL is precut to length with connecting lugs factory machine applied. Soldering is held to an absolute minimum.

The front panel

The front panel is blank except for an indicating AC switch and a reset switch. However, the chassis and mother board are designed so that you may remove the front panel and insert an IMSAI or equivalent front panel. Soon to be available will be our "VIRTUAL OPERATING CONSOLE" especially designed to complement our Mainframe Systems.

Specifications	MCS-112	MCS-122
Dimensions	17 1/4 W x 12 D x 7 1/4 H	17 1/4 W x 19 1/2 D x 7 1/4 H
Power +8 volt DC	17 amps	30 amps
Power ± 16 volt DC	2 amps	4 amps

NOW . . . TEI puts it all together for you.

Mainframe systems (6, 12 and 22-slot) . . . Floppy and mini-floppy disc drive systems (single, double and triple with dual density) . . . a Z-80 CPU with addressable "jump to" and autostart capability (also variable speed control) . . . 8K and 16K RAM . . . 16 Channel A/D and D/A converter . . . 3 serial + 3 parallel multiple I/O . . . and other supporting boards . . . and our newest item, the PROCESSOR TERMINAL — A CRT, keyboard, mini-floppy disc and 12-slot mainframe with a Z-80 CPU — all housed in one quality aluminum case. All of these fine products at prices you will like. **Watch for them all.**

Contact your local TEI dealer or if you are not near one of our dealers, write or call CMC MARKETING CORP direct for more information.

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PLEASE SEND ME:

- ☐ MCS-112 Kit @ 395.00 ☐ MCS-112 Assembled @ 445.00
☐ MCS-122 Kit @ 495.00 ☐ MCS-122 Assembled @ 575.00

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CMC MARKETING CORP

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TEI INC.

OEM SUPPLEMENT AND PRICE LIST

By Robert Purser

Action Audio Electronics, Daly City, California

This list is published for the convenience of our readers. Data are supplied by the manufacturers. INTERFACE AGE assumes no responsibility for inaccuracies or price changes on or before date of publication.

COMPUTER SYSTEMS

Altair 8800A Computer (chassis, power, & CPU)	569.00
Altair 8800B Computer (chassis, power, & CPU)	869.00
Byte Shop Byt-8	349.00
Computer Power & Light COMPAL-80 (assembled)	2,300.00
Cromemco Z-1 (assembled)	2,495.00
Cromemco Z-2K	595.00
Electronic Control Technology ECT-100-8080	320.00
Electronic Control Technology ECT-100-Z80	420.00
Equinox 100	699.00
Forethought Products SIMSI connector and KIM (6502)	
IMSAI 8080 Computer (chassis, power, & CPU)	699.00
IMSAI PKG-1	4,444.00
IMSAI PKG-2	9,013.00
Morrow 8080 MICROPROCESSOR Board	249.95
PolyMorphic Systems POLY-88 System 0	595.00
PolyMorphic Systems POLY-88 System 2	735.00
PolyMorphic Systems POLY-88 System 6	1,175.00
PolyMorphic Disk System (1 disk)	3,250.00
Processor Technology SOL-PC Single Board	475.00
Processor Technology SOL-10 Terminal Computer	795.00
Processor Technology SOL-20 Terminal Computer	995.00
Processor Technology System I	1,649.00
Processor Technology System II	1,883.00
Processor Technology System III	4,237.00
Quay A1 Z-80 CPU, S10, P10, ROM, Programmer Board	450.00
Vector Graphics Vector 1	699.00
Vector Graphics Vector 1 without PROM/RAM	519.00
Vector Graphics Vector 1 without CPU	499.00
Vector Graphics Vector 1 without CPU, PROM/RAM	349.00

Western Data Systems DATA HANDLER (uses MOS 6502)	179.95
Western Data Systems DATA HANDLER (barebones)	79.95

SECOND OR REPLACEMENT CPU BOARD

Affordable Computer Products AZPU (uses Z-80)	249.00
Alpha Micro Systems AM-100 (16 bit)	1,495.00
Cromemco ZPU (uses Z-80/4 microprocessor)	295.00
IMSAI MPU-A (requires additional boards)	190.00
MRS AM6800 CK (uses 6800 MPU)	110.00
MRS AM6800 (without the 6800 MPU chip)	78.00
MRS AM6800 PC Board	30.00
R.H.S. Marketing Piggy-Back Z80-80 (assembled)	159.95
SD Sales Z-80 CPU	149.00
Technical Design Labs Z-80 (uses Z-80)	269.00

READ/WRITE MEMORY BOARD

Advanced Microcomputer Products (8K 500 ns)	198.00
Altair 88-IMCS (1K static)	115.00
Altair 88-2MCS (2K static)	134.00
Altair 88-4MCS (4K static)	175.00
Altair 88-16MCS (16K static)	779.00
Altair 88-4SMC (4K dynamic)	159.00
Associated Electronics 16K Pseudo-Static	349.00
BISI CCD Board (64K)	190.00
Cromemco 4KZ (4K 4MHz) (Bank selectable)	195.00
Cromemco 16KZ (16K 250 nS access and cycle)	495.00
Cybercom MB6A Blue Board (8K static)	250.00
Cybercom MB7 (16K low power static)	525.00
Dutronics 4KLST (4K low power static)	139.00
Dutronics 8KLST (8K low power static)	285.00
E.E.&P.S. 8K (8K static)	295.00
E.E.&P.S. 16K (16K dynamic)	599.00
E.E.&P.S. 32K (32K dynamic)	895.00
Electronic Control Technology 8KM (8K 215 S)	295.00
Electronic Control Technology 17K RAM (16K static)	555.00
Electronic Control Technology 16K RAM (with only 4K)	169.00
Electronic Control Technology 16K RAM (with only 8K)	295.00
Electronic Control Technology 16K RAM (with only 12K)	425.00

Extensys RM64-32 (32K)	895.00
Extensys RM64-48 (48K)	1,195.00
Extensys RM64-64 (64K)	1,495.00
Godbout Econoram (4K static)	99.95
Godbout Econoram II (8K)	163.84
IMSAI RAM 4A-4 (4K without sockets)	139.00
IMSAI RAM 4A-4 (4K with sockets)	159.00
IMSAI 65K (dynamic)	2,599.00
IMSAI 32K (dynamic)	749.00
IMSAI 16K (dynamic)	449.00
Micromation JUMP START (4K static)	145.00
Midwest Scientific Instruments PROM/RAM Board	95.00
Mikra-D MD-2046-4 (4K static)	205.00
Mikra-D MD-2046-8 (8K static)	345.00
Mikra-D MD-2046-12 (12K static)	485.00
Mikra-D MD-2046-16 (16K static)	625.00
MiniMicroMart C-80-4K-100 (4K blank board)	39.95
MiniMicroMart C-80-4K-200 (4K blank board plus)	49.95
MiniMicroMart C-80-4K-300S (4K 2102)	79.95
MiniMicroMart C-80-4K-300LP (4K 91L02A)	99.95
MiniMicroMart C-80-4K-350LP (4K 91L02C)	129.95
MiniMicroMart C80-16K-300 (16K EMM4200)	479.95
Morrow Intelligent Cassette (512 static)	96.00
Omni (16K static)	459.00
Omni with paging option (16K static)	468.00
Prime Radix 40K (dynamic)	1,490.00
Prime Radix 48K (dynamic)	1,580.00
Prime Radix 56K (dynamic)	1,670.00
Prime Radix 64K (dynamic)	1,750.00
Processor Technology 4KRA (4K static with sockets)	154.00
Processor Technology 8KRA (8K static with sockets)	295.00
Processor Technology 16KRA (16K static assembled)	529.00
PolyMorphic Systems MEM-8K (8K static)	300.00
R.H.S. Marketing DYNABYTE 16K (dynamic, assembled)	485.00
J-K Electronics DYNA-RAM 16 (16K)	339.00
S.D. Sales Company 4K (4K static)	89.95
Seals Electronics 8KSC-8 (8K static)	269.00
Seals Electronics 8KSC-Z (8K 250 nS)	295.00
Seals Electronics 8KSCLM (less memory chips)	124.00
Seals Electronics 16KSC-16 (16K static)	579.00
Solid State Music MB-4 (4K 91L02A)	129.95
Solid State Music MB-4 (8K 91L02A)	209.00
Solid State Music MB-4 (board only)	30.00
Solid State Music MB-6 (board only)	35.00
Solid State Music MB-6 (8K 91L02APC static)	265.00
Solid State Music MB-7 (16K static)	525.00
Technical Design Labs Z8K (4K 215 nS)	169.00
Technical Design Labs Z8K (8K 215 nS)	295.00

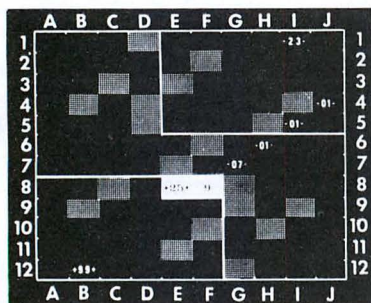
Technical Design Labs Z12K (12K 215 nS)	435.00
Technical Design Labs Z16K (16K 215 nS)	574.00
Technical Design Labs Z Monitor Board with 2K RAM	295.00
Vector Graphics 8K RAM	265.00
Vector Graphics Reset and Go PROM/RAM	89.00
Xybek PRAMMER (256 bytes & 1702 PROMs)	189.00
PROM BOARD	
Altair88-PMC(2K PROM, card only)	85.00
Automated Computer Systems PSFDC (7K EPROM + 1 RAM + adapter board that provides S-100 bus interface for PERSCI's floppy disc controller PCB)excludes EPROMs	160.00
Cromemco BYTESAVER(8K)	145.00
Cromemco 16KPR-K (16K, Bank selectable)	145.00
DigiComm Byteuser(uses 2708)	65.00
Digiteck PROM CARD (2K assembled without PROMs)	56.95
Electronic Control Technology 2KROM/2KRAM	120.00
Godbout Econoram(2K)	135.00
Godbout Econoram(4K)	179.95
Godbout Econoram(8K)	269.95
IBEX 16K PROM Board	85.00
IMSAI PROM 4-4(4K PROM)	399.00
IMSAI PROM 4-512(1/2K PROM)	165.00
Midwest Scientific Instruments PROM/RAM Board	95.00
MiniMicroMart C80-1702-1 (unpopulated)	39.95
MiniMicroMart C80-1702-1 (all except PROMs)	49.95
MiniMicroMart C80-2708-1 (unpopulated)	41.95
MiniMicroMart C80-2708-2 (all except PROMs)	49.95
MiniMicroMart C80-256 (boot strap board, fuselink)	34.95
Processor Technology 2KRO	65.00
Seals Electronics 4KROM	119.00
Solid State Music MB-32K(81702As)	105.00
Solid State Music MB-34K(161702As)	145.00
Solid State Music MB-3(w/o PROMs)	65.00
Solid State Music MB-8(2708)	85.00
Vector Graphics Reset and Go PROM/RAM	89.00
Xybek PRAMMER for 1702 (with a 1702 & RAM)	189.00
PROM PROGRAMMER BOARD	
Altair 88-PPC Programmer (for 1702a, assembled)	456.00
Cromemco BYTESAVER for 2704 & 2708	145.00
Mountain Hardware PROROM (AMI 6834)	164.00
Quay A1 Z-80 with 2708 Programmer	450.00
Szerlip Enterprises The Prom Setter (1702A and 2708)	165.00
Xybek PRAMMER for 1702 (with 1702 & RAM)	189.00

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CIRCLE INQUIRY NO. 32

PLUG IN SOFTWARE BOARD

Computer Kits Power-Start	145.00
Cromemco Z80 Monitor Board with PROM Programmer	220.00
Godbout 8080 Software Board	189.95
Micronics Better But Trap (assembled)	180.00
Midwest Scientific Instruments PROM/RAM Monitor	245.00
National Multiplex Corp. No. 2 SIO with monitor	140.00
Processor Technology ALS-8 (assembled)	425.00
Processor Technology ALS-8 with SIM-1	520.00
Processor Technology ALS-8 with TXT-1	520.00
Technical Design Labs Z System Monitor Board	295.00
Vector Graphics Reset and Go (2 1702A)	129.00
Vector Graphics Reset and Go (3 1702A)	159.00

MEMORY CONTROL BOARD

IMSAI IMM ROM Control Kit	299.00
IMSAI IMM EROM Control Kit	499.00

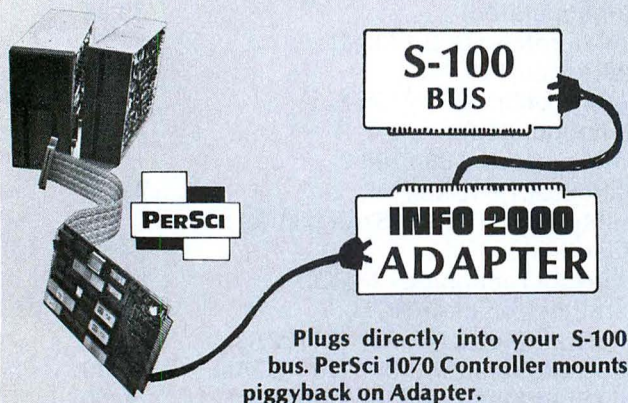
PARALLEL INTERFACE BOARD

Altair 88-4PIO (one port)	105.00
Altair 88-4PIO & 88-PP (two ports)	143.00
Altair 88-4PIO & 2 88-PIO (three ports)	181.00
Altair 88-4PIO & 3 88-PP (four ports)	219.00
Cromemco D + 7AI/O (one port with seven analog ports)	145.00
Cromemco TU-ART (2 ports)	195.00
IMSAI PIO 4-1 (one port w/o cables)	93.00
IMSAI PIO 4-1 & PIOM (two ports without cables)	115.00
IMSAI PIO 4-1 (three ports w/o cables)	137.00
IMSAI PIO 4-4 (four ports w/o cables)	156.00
IMSAI PIO 6-3 (three ports and bus without cables)	139.00
IMSAI PIO 6-6 (six ports and bus without cables)	169.00
IMSAI MOI (two ports & serial & tape interface)	195.00
MiniMicroMart C80-P I/O (two ports)	49.95
MiniMicroMart C80-P I/O with cables	57.45
Morrow Intelligent Cassette w/one port	102.00
PolyMorphic VT1/32 (one input port with video)	185.00
PolyMorphic VT1/64 (one input port with video)	210.00
Processor Technology 3P + S (with sockets)	149.00
Solid State Music I/O-1 (one port)	42.00
Solid State Music I/O-1 (PC board only)	25.00
Solid State Music I/O-2 (two ports)	47.50
Solid State Music I/O-2 (PC board only)	25.00
Technical Design Labs Z Monitor Board (one port)	295.00
WIZARD PSIOB (3P + S compatible)	125.00

SERIAL INTERFACE BOARD

Altair 88-2SIO (one port)	148.00
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INTERFACE Your PerSci To S-100



KIT INCLUDES:

- High quality etched circuit board
- Necessary sockets and ICs
- Special connector for 1070 Controller
- Circuitry for three 2708 EPROMs*
- Circuitry for two 2114 RAMs*
- Prototype area
- Instructions for assembly and use, including Wait-State in proto-type area

FEATURES:

- INFO 2000 Adapter EPROM and RAM, totalling 4K, may be addressed anywhere within 4K boundary via jumpers
- Address Controller to any I/O port via jumpers
- Wait-State added easily with addition of two 16-pin ICs*

*You supply chips for optional features

INTRODUCTORY PRICE: \$85.00

DELIVERY: Beginning July, 1977

Write for information and
specifications:

INFO 2000

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CIRCLE INQUIRY NO. 23

The new generation of Diskette Drives is here and under control.

PerSci has it—a family of diskette drives “design-years” ahead of competitive drives—now available in complete low cost subsystems for interface to 8080, 6800 and other major microprocessors.

The Highest Performance Diskette Drives:

PerSci diskette drives, both single and dual head units, offer a combination of performance features unique in the marketplace while still maintaining compatibility in existing systems:

- ☐ Voice coil positioning for access speeds seven times faster than competitive drives (76 tracks in 100 ms)
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- ☐ Automatic electric loading simplifies operation and protects media
- ☐ Small size permits 5 single drives or 4 dual drives to be mounted vertically in a 19 in. rack

The Most Powerful Diskette Drive Controller

The PerSci Model 1070 Diskette Drive Controller puts the advanced performance of PerSci drives to work in microprocessor based systems. An IBM format compatible, “intelligent” controller, the Model 1070 will handle from 1-4 drives with minimum demand on the host system.

In fact, with addition of a power supply and keyboard to the PerSci subsystem, the user can

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Controller features include:

- ☐ 8080 microprocessor
- ☐ Formatter/control IC
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- ☐ 1K data buffer
- ☐ 8080 or 6800 microprocessor interfaces
- ☐ RS-232 serial interface optional
- ☐ IBM data format

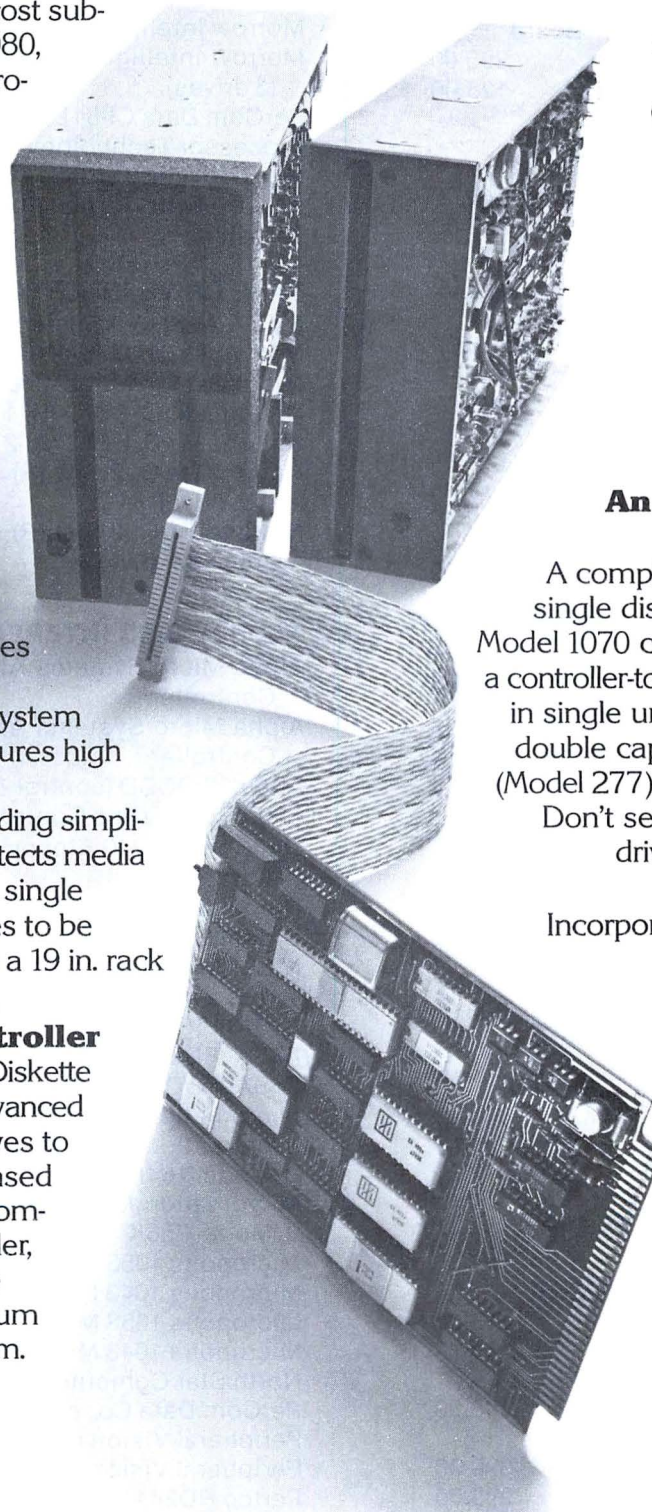
An Economical Diskette Drive Subsystem

A complete subsystem including a single diskette drive (Model 70), the Model 1070 controller with interface and a controller-to-disk-drive cable is available in single units or OEM quantities. For double capacity, a dual diskette drive (Model 277) subsystem is also available.

Don't settle for yesterday's diskette drive. Get the new generation under control from PerSci, Incorporated, 12210 Nebraska Ave. W. Los Angeles, CA 90025 (213) 820-3764



Peripherals a Generation Ahead.



Altair 88-2SIO & 88-SP (two ports)	186.00
Cromemco TU-ART (2 ports)	195.00
IMSAI SIO 2-1 (one port w/o cables)	125.00
IMSAI SIO 2-2 (two ports w/o cables)	156.00
IMSAI SIO (serial, parallel, & tape interface)	195.00
Morrow Intelligent Cassette with one port	108.00
MiniMicroMart C80-SI/O-300 (TTL)	44.95
National Multiplex Corp. No. 2 SIO with ROM	140.00
Processor Technology 3P + S (with sockets)	149.00
Solid State Music I/O-2 (two ports)	47.50
Solid State Music I/O-2 (PC board only)	25.00
Technical Design Labs Z Monitor Board (two ports)	295.00
WIZARD PSIOB (3P + S compatible)	125.00

ANALOG INTERFACE BOARD

Cromemco D + 7AI/O (7 analog inputs & 7 outputs)	145.00
Micro Data ADC/DAC	250.00
MITS 88-ADC	
MITS 88-Mux (assembled only)	319.00
PolyMorphic Systems ADA/1 (1 analog output)	145.00
PolyMorphic Systems ADA/2 (2 analog outputs)	195.00

MODEM BOARD

D.C. Hays 80-103A (data communications adapterboardmodem)	279.95
International Data Systems 88-MODEM	199.00

VIDEO INTERFACE BOARD - BLACK & WHITE

Computer Kits INTELLITERM (characters)	395.00
Computer Graphics GDT-1 (graphicsandlightpen)	185.00
Environmental Interface II (monitor)	245.00
Environmental Interface III (oscilloscope)	495.00
Micro GRAPHICS "THE DEALER" (graphicsandcharacters)	249.00
MiniTerm Associates MERLIN (without memory)	269.00
MiniTerm Associates MERLIN (with memory)	303.95
MiniTerm Associates MERLIN Super DenseGraphics	308.00
PolyMorphic VTI/64 (graphics and characters)	210.00
Processor Technology VDM-1 (characters)	199.00
Solid State Music 64x16 (graphics and characters)	189.95

VIDEO INTERFACE BOARD - COLOR

Cromemco TV DAZZLER (graphics)	215.00
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TV CAMERA INTERFACE BOARD

Cromemco 88-CCC-K	195.00
Cromemco 88-CC-K with Camera Kit 88-ACC-K	390.00
Environmental Interface 1	295.00

Environmental Interface with camera	595.00
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AUDIO CASSETTE INTERFACE BOARD

Affordable Computer Products Dual Triple Standard	135.00
Altair 88-ACR	138.00
DAJEN Cassette Interface	120.00
DAJEN Universal Cassette Interface (Relay Control)	135.00
IMSAI MIO (tape interface, parallel, & serial)	195.00
MiniTerm Associates MERLIN with cassette interface	298.00
National Multiplex Corp. No. 2 SIO WITH ROM	140.00
Morrow Intelligent Cassette Interface	96.00
Morrow Intelligent Cassette Interface (3 drives)	102.00
PerCom Data CI-812	89.95
Processor Technology CUTS	87.00
RO-CHE with Tarbell (two ports)	215.00
RO-CHE with Tarbell (four ports)	245.00
Tarbell	120.00

TAPE DRIVE INTERFACE BOARD

MECA ALPHA-1 System	400.00
Micro Design Model 100 (assembled)	600.00
Micro Design Model 200 (assembled)	875.00
National M.C. 2 SIO (R) 1 ROM	169.95
National M.C. 2 SIO (R) 2 ROM	189.95
National M.C. 2 SIO (R) with 3M3 (3M drive)	369.90
National M.C. 2 SIO (R) with 3M3 (mini 3M drive)	339.90

FLOPPY DISC INTERFACE BOARD

Alpha Micro Systems AM-200 Controller	695.00
Alpha Micro Systems AM-201 Controller	695.00
Altair 88-DCDD (control & disc)	1,530.00
CHP Floppy Disc Controller	300.00
DigiComm 8040 Floppy Disc Controller	265.00
Digital Systems IBM compatible	1,595.00
Digital Systems dual IBM compatible	2,170.00
iCOM Microfloppy Model FD2411 (assembled)	1,095.00
IMSAI FIF	599.00
IMSAI FDC2-1 & FIF	1,694.00
IMSAI FDC2-2 & FIF	2,789.00
Micromation Universal Disc Controller	229.00
Micromation MACRO DISC System, Model 164K	900.00
Micromation MACRO DISC System, Model 256K	1,100.00
Micropolis 1053 Mod II (630K)	1,795.00
Micropolis 1043 Mod II (315K)	1,095.00
Micropolis 1053 Mod I (286K)	1,545.00
Micropolis 1043 Mod I (143K)	945.00
North Star Computers MICRO-DISK	699.00
PerCom Data Co.	695.00
Peripheral Vision interface & floppy	750.00
Peripheral Vision IFF-KC interface	245.00
Pertec RD2411	1,095.00

Processor Applications FDC-1016K Controller	395.00
Processor Technology Helios (dual)	1,895.00
Synetic Designs interface & floppys	2,690.00

HARD DISC INTERFACE BOARD

IMSAI DISK-50	12,500.00
IMSAI DISK-80	14,700.00
IMSAI DISK-200	24,500.00
IMSAI Interface (assembled)	3,900.00

HARDWARE MULTIPLY/DIVIDE BOARD

GNAT 8006 Module (5 μ -sec. process time)	225.00
GNAT 8006 Module (2.5 μ -sec. process time)	275.00
North Star Computers (floating point)	359.00

CALCULATOR INTERFACE BOARD

COMPU/TIME CT 100	195.00
COMPU/TIME C 101	149.00

SPEECH SYNTHESIZER BOARD

Ai Cybernetic Systems Model 1000	325.00
Computalker Speech Synthesizer CT-1	395.00
Logistics Synthesizer (multipurpose)	525.00

SPEECH RECOGNITION BOARD

Heuristic Speechlab	245.00
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JOYSTICK INTERFACE KITS

Cromemco Joystick Kit & D + 7A I/O	210.00
Cromemco Dual Joystick Kits & D + 7*a *i1/2o	275.00

INTERRUPT BOARD

Altair 88-VI	138.00
Cromemco TU-ART	195.00
El Paso Computer Group (board only)	20.00
IMSAI PIC-8 (with internal clock)	125.00

REAL TIME CLOCK

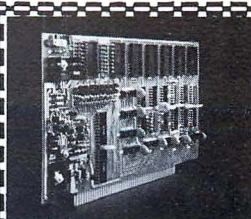
Comptek CL2400	98.00
COMPU/TIME CT 100	195.00
COMPU/TIME T102	149.00
International Data Systems SMP-88	96.00
Lincoln Semiconductor Clock and Display Driver	95.00

AC POWER CONTROL

Comptek PC3216 Control Logic Interface	189.00
Comptek PC3216 & PC3202 Power Control Unit	228.50
Comptek PC3216 & 16 PC3202 16 Channel System	821.00
Comptek PC3232 Control Logic Interface	299.00
E.E.&P.S. 115V I/O	249.00
Mullen Relay/Opto Isolator Control Board	117.00

BATTERY BACK-UP BOARD

Seals Electronics BBUC (12 amper hours)	55.00
E.E.&P.S.	55.00



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**An extraordinary 2k memory board
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- ★ On-board 1702A PROM programmer
- ★ 256 bytes of RAM plus space for 1792 bytes of read-only memory (seven 1702A EPROMs)
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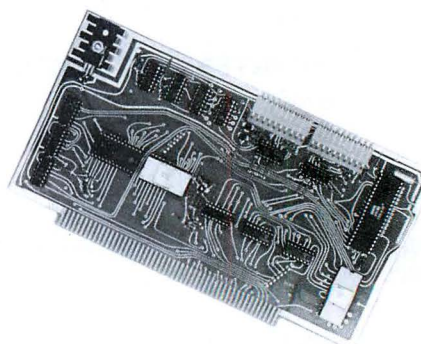
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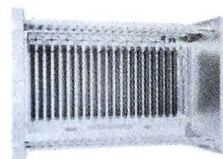
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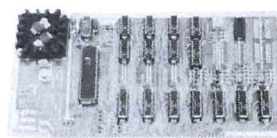


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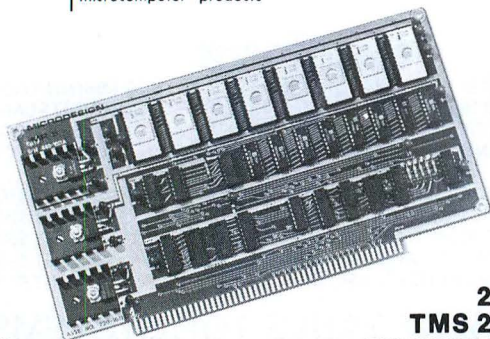
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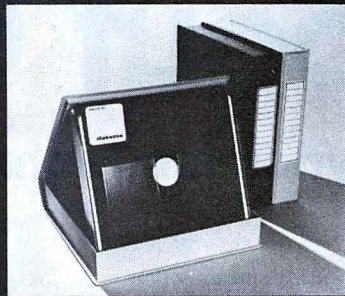
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By D. E. Freeman, and O. R. Perry.

374 pages, \$17.50

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By T. G. Lewis, and J. W. Doerr.

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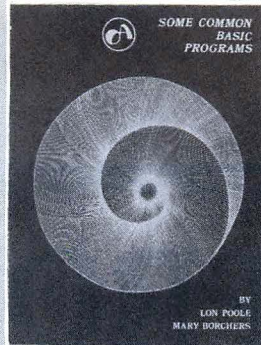
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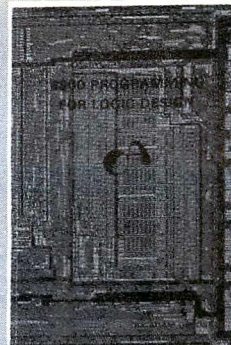
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This important handbook features recent advances in the field, new design material, and a comparison between continuous and digital systems. Areas covered include sampled-data systems and analog-to-digital conversion; discrete and fast Fourier transforms; nonrecursive and recursive digital systems; simulation of continuous systems; digital filter analysis; and digital time series synthesis and analysis.

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It is the purpose of this book to bridge the gap between the elementary microprocessor programming techniques and the more sophisticated techniques that are becoming available. A good understanding of a microprocessor's features and limitations, as well as established programming techniques, will make it much easier to write simple programs and to make best use of advanced computer-oriented programming systems.

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An authoritative, practical guide to the

construction, operation, programming and applications of perhaps the most significant new technological achievement of our time. Tells what microprocessors are, how they work, where they're used and how YOU can use them in your own applications!

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13

Master Handbook of Digital Logic Applications

By William L. Hunter. 390 pages, \$7.95

In addition to TTL, the author covers CMOS, HTL and ECL—plus a section on special discrete logic circuits and techniques using miniature transistors and FETs. With the clear and simple instructions in this book, even a beginner can build many useful digital devices from computer circuits to motor speed controls.

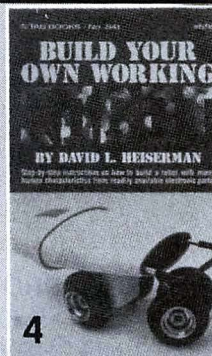
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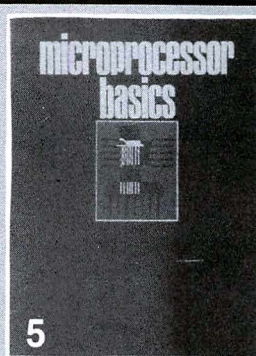
TYCHON's 8080 Octal and Hex Code Cards

The code cards are a slide rule-like aid for programming and debugging 8080 software. Both cards contain all the standard mnemonics and either their corresponding octal or hex codes. The pocket size cards are color-coded and are 6.5 by 3 inches (16 by 8 cm) with instructions provided. The back of both cards is printed with an ASCII code chart for all 128 characters plus the 8080's status word and register pair codes. \$2.95 each.

(Add 25¢ each for postage and handling, 50¢ each outside U.S.A.) Allow 3 to 4 weeks delivery.



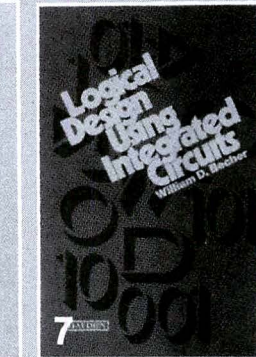
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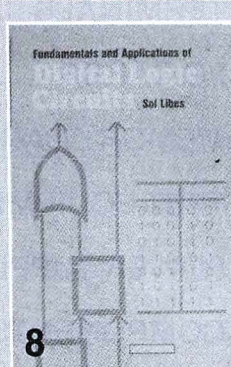
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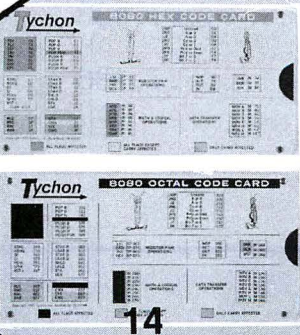
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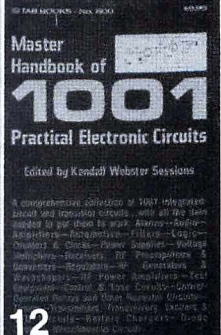
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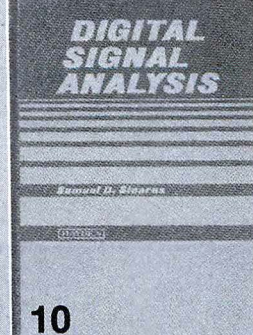
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NEW PRODUCT GUIDE

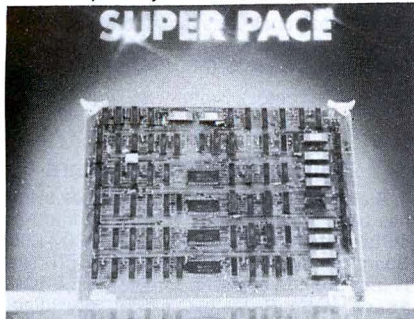
THIS NEW PRODUCT GUIDE HAS BEEN COMPILED AS A SPECIAL FEATURE TO INTRODUCE THE MANY NEW PRODUCTS AND COMPANIES ENTERING THE HOME AND SMALL BUSINESS COMPUTING MARKET.

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Microprocessor Kits

High Speed Bipolar Pace CPU On A Single Printed Circuit Board

National Semiconductor Corporation has gone into production on a low cost, single board bipolar implementation of its PACE microcomputer that is 30 percent more powerful than some minicomputers and 2 to 2½ times more powerful than most single board microcomputer systems.



The new unit, called "Super-PACE," is available now. It is a high-speed schottky transistor-transistor logic enhancement of National's 16 bit p-channel metal oxide semiconductor PACE microprocessor.

The 8.5 x 11 inch CPU board, designated the IPS-16C/100, features a 220-nanosecond cycle time and an average instruction execution interval of 1 microsecond. Logic and arithmetic instructions such as "and," "or," and "add" have a typical instruction execution time of 1.1 microseconds. Stack instructions range from 1.05 to 1.27 microseconds. Register data-transfer instructions are in the 660 nanose-

cond range and a load or store memory transfer instruction typically requires 880 ns to 1.06 microseconds. For more sophisticated operations characteristic of high end minicomputers the speed of Super-PACE is even more impressive. A normalize instruction, for example, takes about 2 microseconds and a 16 by 16-bit multiply or divide takes about 13 microseconds.

The microprogrammed Super-PACE board features a 16-bit address bus and a separate 16 bit bidirectional data bus for faster execution. It is implemented with 80 bipolar schottky MSI chips. The processor portion of the board consists of eight 64-bit edge-triggered registers, four 16-bit binary arithmetic logic units and two tri-state 8-bit universal input/output shift registers. In addition to an on-board clock generator, the timing and control portion of the board contains eight 2-kilobit bipolar read-only memories for microprogram storage of the 75 instructions, 7 to 10 decode ROM packages and 5 to 7 tristate counters for microprogram address control. Another 40 to 50 chips perform the I/O control, address register and I/O data buffer functions. Built-in bus request logic easily implements data transfer synchronization, and implementation of external bus controllers.

The Super-PACE IPS-16C/100 CPU board comes supported by a full line of memory and peripheral boards as well as software and programming aids. A six slot prototyping system incorporating the Super-PACE CPU board, a 16k by 16 RAM board, an 8K by 16 PROM board, an I/O communications interface board, and a software package is available for \$3,735.

In single unit quantities, the price of the IPS-16C/016 sixteen kilobit RAM board is \$1,400.

An 8k by 16 bit RAM board, the IPS-16C/008 is also available, for \$1,190. The IMP-16P/0088, an 8k by 16 PROM board is \$410. An ultraviolet erasable PROM version, the IMP-16P/008P, is \$1,498. The IPS-16P/801 communications I/O board is \$495. The IPS-16F/001 system monitor and debug software package for Super-PACE is \$300 and the IPS-16S/100C PACE/Super-PACE cross-assembler is \$175.

For further information, contact National Semiconductor Corporation, Computer Products Group, 2900 Semiconductor Drive, Santa Clara, California 95051, (408) 737-5000.

CIRCLE INQUIRY NO. 100

Plug-Compatible Series/80 Microcomputer Boards

The Microcomputer Systems Group of National Semiconductor has unveiled the first line of microcomputer CPU (central processing unit) and memory boards which are form fit and functionally compatible with Intel's SBC 80/10 single board computers. The National CPU is priced at \$265 when purchased in quantities of 100 or more, which is 10 percent lower than Intel's.

The initial entry, designated "Board-Level Computer" BLC 80/10 is accompanied by the BLC 016 16K by 8 bit random-access memory (RAM) card, the BLC 406 6K by 8 bit read-only/programmable read-only memory (ROM/PROM) card, the BLC 905 universal prototype card, and the BLC 80P prototype package with card cage and cables. To complete the system, the BLC 104 memory-I/O expansion card, the BLC 508 I/O expansion card and the BLC 416 16K ROM/PROM expansion card will be available within a few months.

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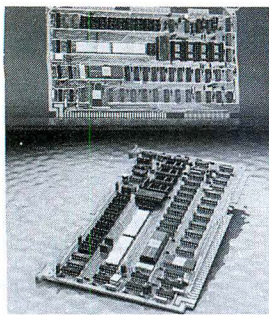
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Unlike the 90-day warranty on competitive units, the National Series/80 microcomputers have a full-year warranty on parts and labor. Schare attributes this extended warranty policy to National's 5-year experience in manufacturing and testing of microcomputer-oriented products. National intends to become a strong factor in designing, manufacturing and marketing all Series/80 CPU, memory, interface, and I/O boards and associated hardware. The introduction now of the CPU card marks the beginning of an extensive line of Series/80 hardware, software, and peripheral products will be introduced throughout the year.

The Microcomputer Systems Group is one of four groups in the newly-formed National Semiconductor Computer Systems organizations. It is dedicated to design, manufacture and marketing of board-level, subsystem-level and system-level microprocessor-based products.

For further information, contact National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 101

Cramerkit™

A ready-to-assemble microcomputer available in several models, was introduced just eighteen months ago by Cramer Electronics, Inc. Termed CRAMERKIT™, the product has been on the market for several months and now has been joined by several software kits and custom options designed to save designers' time.



Developed in concert with leading microcomputer design consultants, the specially designed kits come equipped with either an Intel 8080, a Motorola 6800, a Texas Instruments TMS 8080, a Texas Instruments 9900, a Mostek F-8, an RCA COSMAC, or AMD 9080 as the central processing unit (CPU). Each CRAMERKIT contains all the active and passive components (except board and power supply) necessary to build a functional microcomputer.

Each kit includes, in addition to all parts, engineering documentation, literature, schematic diagram, and test programs recorded on a cassette tape. The complete components and documentation package enables a designer to design and fabricate a custom microcomputer to suit his specific application.

Wholesale availability of this highly useful tool, at the prices between \$495 and \$595, has already contributed to speeding widespread use of microcomputers throughout the industry. This is an event, incidentally, which has

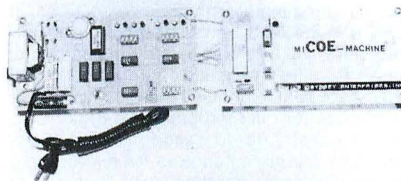
also positively affected the entire electronics industry.

For further information, contact: Cramer Electronics, 85 Wells Ave., Newton, Mass. 02159, (617) 969-7700.

CIRCLE INQUIRY NO. 102

Micro Vectorbord

A new microcomputer kit is available now. This is a complete microcomputer; when built all you do it plug it in. It is a low priced kit aimed at the hobbyist market, but is being used by engineers also. The kit is assembled on two pieces of Micro Vectorbord (TM Vector Electronics) by hardwiring.



One board contains the power supply (5V, 1A, fused) and the I/O and control section... 8 toggle switches, 8 LEDs, 4 control switches, and ICs. The second board contains the RCA COSMAC 1802 CPU, 256 bytes memory, clock circuit, and plenty of room for expansion. All ICs are provided with sockets. Comprehensive instructions, 1802 manual, hardware, and wire are included.

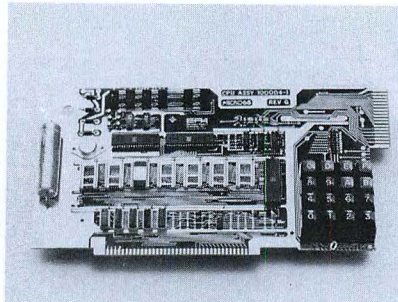
This kit is designed for maximum flexibility making it useful in education, prototyping, or for the hobbyist. Wire wrap is available for \$10.00 with kit or \$15.00 separately — includes sockets, wire and tool with instructions. The system can be expanded very easily. Full hardware and software support is available. Accessories will be available including cabinet, memory, I/O kits, other power supplies, PC boards, etc.

The mail order price is \$90.00 (postage, insurance, and handling included). Unconditionally guaranteed. Quantity discounts are available. Dealer inquiries invited. Allow 3-6 weeks delivery. School and Club discounts. For further information, contact Child Odyssey Enterprises, Inc., P.O. Box 137, Alamogordo, New Mexico 88310.

CIRCLE INQUIRY NO. 103

Micro-68a Computer Now Available in Kit Form

After two years production of 1000 units, EPA has finally decided to offer the popular Micro-68 computer in kit form at \$385.00 complete with power supply and cabinet.



The Micro-68 uses the industry standard 6800 microprocessor which is now manufactured by Motorola, AMI, Fairchild, Hitachi, and Thomson CSF. The kit comes complete with a 16 key hexadecimal keyboard and six digit hex

display. Sockets are provided for 768 words of RAM (128 words supplied with kit). The powerful MON-1 keyboard operating system is supplied in PROM form so that the computer is ready to run upon completion of construction. The following commands are part of MON-1, inspect and change, load users program, run users program, insert break points, save stack, vector interrupts; sixteen bits of I/O are provided to the side connector, and the main bus is available at the front connector. Full bus buffering provisions are provided on the board. A piggy-back teletype/CRT/Audio Cassette Adapter is available.

The Micro-68a is fully compatible with the Micro-68b for later upgrading into a larger system. The Micro-68a is available from stock.

For additional details contact: Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110, (714) 276-8911.

CIRCLE INQUIRY NO. 104

Z-80 Microprocessor Board

A single board Z-80 microprocessor system has been announced by Mini Micro Mart. It is software compatible with the Intel SBC 80/I-O Board but uses the new Zilog Z-80 CPU. There is provision on-board for three 2708 E PROMS, 1K of static RAM, two 8255's (providing 9 parallel ports), and an 8251 USART for a serial interface. Both a 20 mil current loop TTY and an RS-232-C interface are on-board with provisions for baud rates from 110 to in excess of 9600.

Full address decoding is provided for both the on-board memory and the I/O devices. It will also run Altair, IMSAI, and Processor Technology software with very minor modifications. The board is 7" x 10 1/2" of plated through epoxy glass material and with gold fingers on a dual 43-156 center format.

It is part of a complete family which includes 4K and 16K static RAM boards, PROM boards and a scientific calculator interface. A complete system in a self-contained table-top cabinet, including Teletype printer, is available. The CPU board system is available in kit form starting at \$199.95, or assembled and tested at \$249.95, in single unit quantities. As an introductory offer, listings for our 5K BASIC and a powerful operating monitor, which provides for entry and dumping in both Octal and Symbolic, are included.

For additional information, contact Mini Micro Mart, 1618 James Street, Syracuse, NY 13203 (315) 422-6666. Delivery is stock to 30 days.

CIRCLE INQUIRY NO. 105

Z-80 SAM

The Z80 System Adaptor Module (Z80-SAM) is now available direct from the factory for engineers who wish to develop Z80-based products using the MDS-800.

The Z80-SAM, consisting of the powerful Z80/MDS Microcomputer Board, Z80/MDS disk resident assemblers, and Z80/MDS monitor software, totally compatible with the MDS-800, provide the only Z80 hardware-software development aid specifically designed to operate within the MDS environment and to be bus compatible with it. No other microprocessor system can provide MDS users with comparable power at the low price of \$1,495.00.

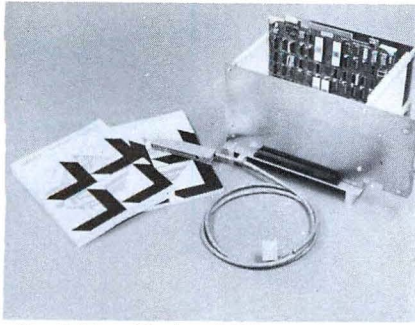
For further information, contact RELMS, P.O. Box 6719, Santa Clara, CA 95150, (408) 248-6356.

CIRCLE INQUIRY NO. 106

F8 Formulator Mark I

The first member of the Formulator family, the F8 Formulator Mark I, is a basic microcomputer development tool providing the hardware necessary to build prototype systems. In-

cluded in the basic system is the Formulator Processor Module with the F8 CPU, Static Memory Interface, Dynamic Memory Interface, and Program Storage Unit Devices.



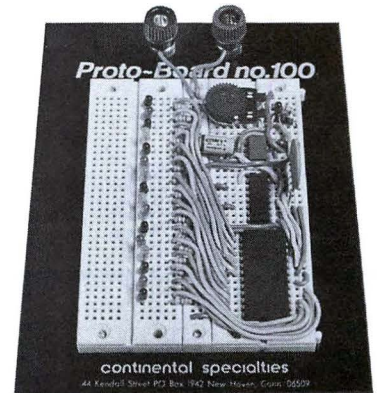
The Fairbug Monitor ROM, consisting of a 1K byte monitor debug package, is included in the Program Storage Unit on the Processor Module. Fairbug provides the Mark I with sufficient debug capability to load a program, examine registers, monitor and alter memory locations, store a program on an external file, and generate a tape suitable for burning PROM memory devices. The Mark I also comes equipped with a 13-slot card case and motherboard for attaching the modular Formulator printed circuit boards. Three slots are wired for the console control modules and one is dedicated to the Processor Module. The other nine connectors are general purpose slots which can accept additional Formulator modules for system expansion. Cables and documentation are also included in the F8 Formulator Mark I system, including a peripheral interface cable which can connect the Mark I to a Teletype ASR33 or TI Silent 733 for external communication. For further information contact Fairchild Micro Systems, 1725 Technology Drive, San Jose, CA 95110, (408) 998-0123.

CIRCLE INQUIRY NO. 107

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The PB-100 is only one of our family of solderless Proto-Board breadboarding units, designed to help you assemble, test and modify circuits as fast as you can push in or pull out a lead. *Preassembled* sockets with durable 5-point terminals provide low-resistance interconnections you can arrange and re-arrange at will.

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THE PAIA 8700 COMPUTER/ CONTROLLER

An exceptional price on an applications oriented 6503 based micro-processor system featuring:

- 1K bytes RAM locations (512 bytes supplied)
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- 2 - 8 bit output ports (1 latched, 1 buffered)
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- 2 - latched seven segment displays (used by monitor to display memory location and contents - easily user programmed)
- Optional cassette interface (\$22. 50) fits entirely on the processor board.

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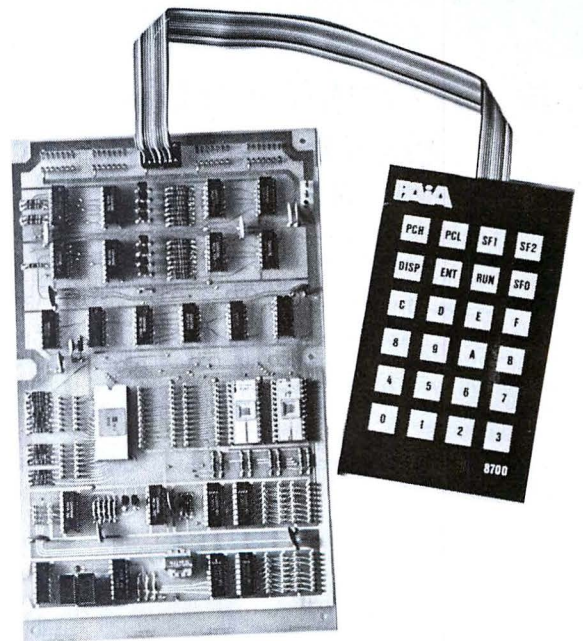
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Oklahoma City, OK 73116

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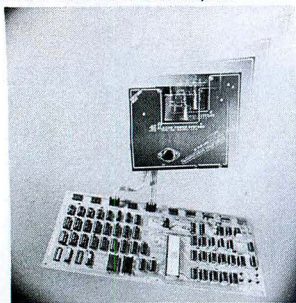
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CIRCLE INQUIRY NO. 37



Super Starter Series — TEC-9900-SS

The Technico Super Starter System, part number TEC-9900-SS, featuring the TI-TMS-9900 16-bit Microprocessor, comes on a 7" x 16" PC Board with capacity for 2K Bytes each of RAM, PROM, and E-PROM. It has on board an RS232 and 20ma current loop and implements 8 hardware interrupts.



The system also includes a 13 instruction monitor, which allows inspection and modification of the 9900 registers. An E-PROM Programmer for programming into 2708's user programs directly from RAM to E-PROM is included. A compatible Interface Board TEC-9900-AIO- provides 32 Bits of input and output and implements six interval timers and six RS232 interfaces. The system is expandable to a full 65K Byte Minicomputer.

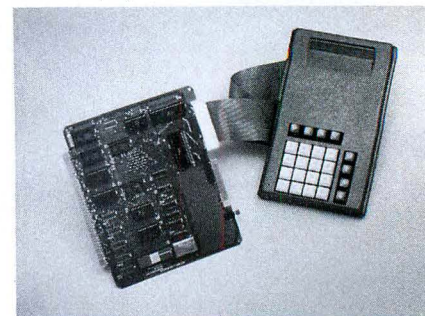
Contact Technico, Inc., 9130 Red Branch Road, Columbia, MD or call Toll Free 1-800-638-2893.

CIRCLE INQUIRY NO. 108

MEK 6800D2

Audio Engineering is pleased to offer the Motorola MEK6800D2 Kit fully assembled and ready to operate with the addition of a regulated 5 volt, 1 amp power supply. The

assembled version, designated Model SY1-068 includes sockets for all IC's, a stand for the CPU board, and an attractive case for the Keyboard/Display.



The SY1-068 has a 1K monitor, 256 bytes of RAM, serial I/O (used for cassette interface), parallel I/O, and Xtal clock.

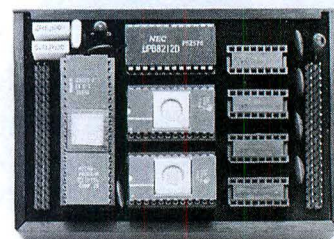
The Keyboard/Display terminal provides 6 HEX LED's, HEX input, punch tape, load tape, single step, set and clear breakpoints, memory examine and change, escape to monitor, and go to user program.

The SY1-068 is \$269.00. The case can be purchased separately for \$12.50. Additional 128X8 RAM is \$7.50. A power supply kit with 60 Hz clock is \$29.95. Audio Engineering, 121 Wisconsin N.E., Albuquerque, N.M. 87108, (505) 255-6451.

CIRCLE INQUIRY NO. 109

The Complete Controller in a Box

The CC-48 is a versatile computer module which can put your environment under your control. Build your own intelligent tanks. Develop an auto-pilot for your RC plane. Put a module in your car to display acceleration, MPG, time, ETA, H.P., and provide a sophisticated security system! Use it to control you pet robot, your electric trains, or your home security system without losing your Altair.™



The CC-48 contains 1 8035 cpu (8)48 w/o EPROM), 1 8212 address latch, 1 2708 1Kx8 EPROM, crystal oscillator, and gold plated wire wrap sockets. Requires +12v, +5v, -5v. Price \$149.00.

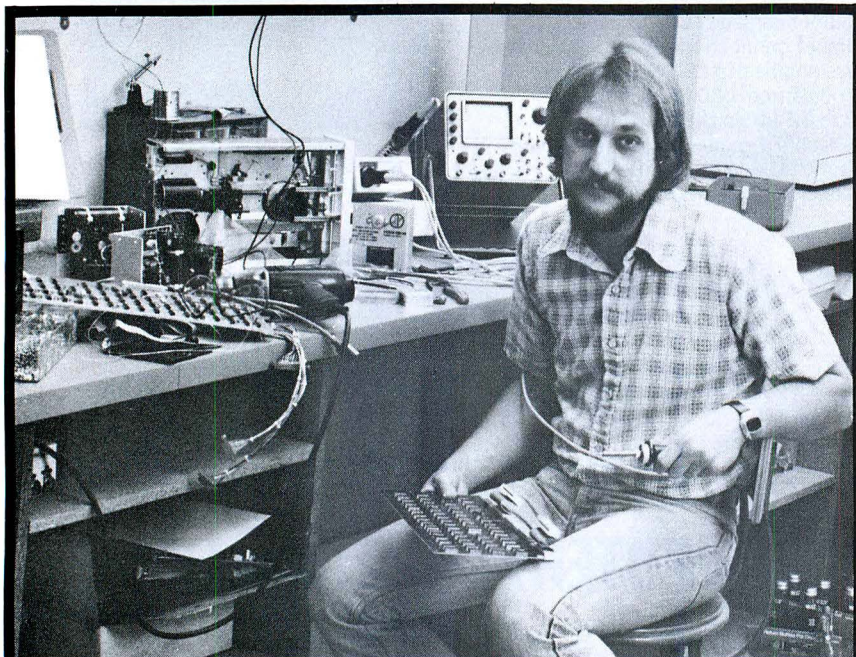
The CC-48-1 contains 1 8748 (8048 with 1K EPROM), 1 8212 address latch, crystal oscillator, gold plated wire wrap sockets. Only requires +8 to 12v unregulated supply. Price \$249.00.

All above kits include OAE documentation and 200 page Intel® Manual and Application notes. Additional TMS-2708 EPROMS, \$48.00; 8080 to 8048 cross assembler (with purchase of above kits), \$48.00; 8748 Programmer, \$249.00; 2708/16 PROM Programmer, \$249.00. For further information contact Oliver Audio Engineering, Inc., 7330 Laurel Canyon Blvd. No. Hollywood, CA 91605, (213) 765-8080.

CIRCLE INQUIRY NO. 110

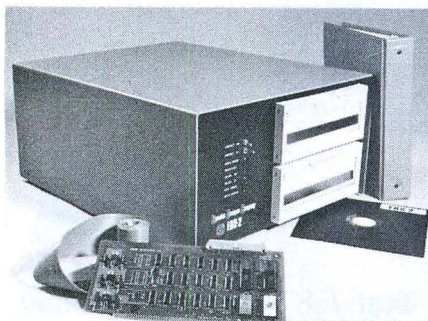
A Computer That Thinks in BASIC for Only \$298.

Ohio Scientific's new Model 500 CPU board can be used as a stand-alone computer or as



IF I'D ONLY KNOWN, I WOULD HAVE BOUGHT THIS ASSEMBLED!

- It isn't as simple as it seems to adopt a floppy disk system to your microprocessor. You need power supplies, interface card, controller, cables, fan and a cabinet to put it in. In most cases you have to modify the disk software for your computer.
- The Syntec Designs Company FDS-2 FLOPPY DISK system comes complete with ICOM™ assembler, text editor, and executive system—all packaged in an attractive cabinet. Because it is ready to run, there is no software patching for I/O handlers, initialization routines, or vector assignments.
- Save yourself Frustration. Buy Syntec Designs Company's FLOPPY DISK SYSTEM.



Contact your local computer store or write:

 Syntec Designs Company.

P.O. Box 2627
Pomona, California 91766
Phone: (714) 629-1974

CIRCLE INQUIRY NO. 50

the CPU in a larger system. The board accepts 8K of ROM, 4K of RAM, 750 bytes of PROM, an ACIA based serial port, a 6502 processor, and full buffering for expansion!



The Model 500 is available completely assembled with 8K BASIC in ROM for only \$298.00. By simply adding a terminal and power supply, the user has a complete system which will accept up to 200 lines of BASIC program without expansion.

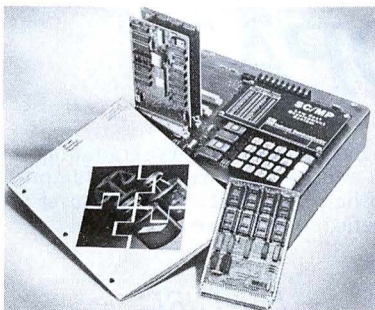
The Model 500 is software and hardware compatible with Ohio Scientific's 400 kits and Challenger products, thus, allowing expansion to a large system.

The board is available enclosed with power supply as the Model 500-1 and is available in an eight slot Challenger case as the Model 500-8. For further information contact, Ohio Scientific Instruments, 11679 Hayden St., Hiram, Ohio 44234.

CIRCLE INQUIRY NO. 111

Microprocessor & Memory Eurocards Speed Overseas System Design

Four new compatible CPU and memory application cards, the first with standard Eurocard size and bus configuration, allow fast, inexpensive construction of microprocessor systems destined for the European market.



The new family consists of the ISP-8C/100(E) 8-bit SC/MP cpu card, one ISP-8C/004(E) 4K by 8-bit random-access memory (RAM) card and the ISP-8C/004 B or P (E) 4K by 8-bit read-only memory (ROM)/programmable read-only memory (PROM) cards. All measure 160mm long by 100mm wide and have 64 edge connectors (32 each side) on 2.54mm centers.

For small applications, the ISP-8C/100(E) serves as a stand-alone controller. It has 256 words of RAM and sockets for 512 words of ROM on the board as well as complete timing, control and power-up circuits. For larger applications, the cpu card has on-card decoding for separate address and data busses, allowing convenient memory expansion to 64K words and peripheral interfacing with compatible Eurocards.

The ISP-8C/004P(E) PROM Eurocard has 4K by 8-bits of unprogrammed PROM supplied by eight 512 by 8-bit chips (MM5204Q) while the ISP-004B(E) ROM/PROM Eurocard has sockets for up to eight 512 by 8-bits of erasable PROMS (MM520Q/MM5244) or pin compatible ROMs (MM5214). Both cards contain complete control circuits, module-select logic, and input/output buffers.

System software includes ROM resident assemblers, IMP-16 and PACE cross

assemblers, FORTRAN cross assemblers, ROM resident NIBL—National's Tiny Industrial Basic Procedure Language, and ROM resident loaders and debug programs.

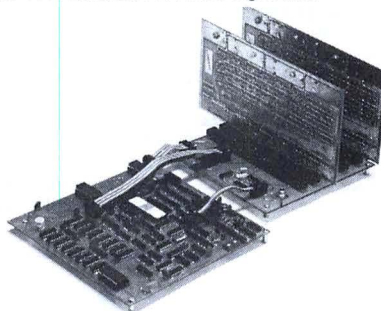
Power supply requirements are +5V and -12V for the cpu and ROM/PROM cards, +5V for the RAM card. Mating connectors, compatible card cages, extender cards, wrapped-wire and interface cards are available from a number of sources.

The ISP-8C/100(E) SC/MP cpu card is priced at \$250 each in unit quantities; \$218 each in quantities above 25. The ISP-8C/004(E) RAM card is priced at \$225 each in unit quantities; \$219 each above 25. The ISP-8C/004 card with empty ROM/PROM sockets is \$125 each in unit quantities; \$119 above 25. The ISP-8C/004P(E) card, with 4K words of memory supplied, is \$525 each in unit quantities; \$457 each above 25. Delivery is stock to 15 days ARO. For further information, contact National Semiconductor Corporation, 2900 Semiconductor Dr., Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 112

Kit for Fast Bipolar Emulation of the 8080A Microcomputer

Bipolar emulation of the popular Intel 8080A microcomputer system, with speed improved by as much as 9 times, is now possible with a new 8080 Emulator Kit from Signetics.



The Kit, designated the 3000KT8080SK, is a microprogrammed microprocessor using Schottky LSI components to implement the 8080A emulation at speeds that allow expansion of existing 8080A-based systems with no change in software.

The 3000KT8080SK is now available from Signetics and its authorized distributors at a unit price of \$299.

For further information contact Signetics, 811 East Arques Ave., Sunnyvale, CA 94086, (408) 739-7700.

CIRCLE INQUIRY NO. 113

Signetics 8X300, the Only Bipolar Microprocessor with a Fixed Instruction Set

The only high-speed monolithic microprocessor with a fixed instruction set, recently introduced by Signetics, has been found ideal for many military applications. The 8X300 microprocessor uses bipolar Schottky technology and a partitioned bus structure to achieve state-of-the-art improvements in operational simplicity and system efficiency.

The 8X300 is designed with a dual purpose address/data bus partitioned into a right and left bank, with logic distributed along the data path.

The microprocessor is being marketed by the firm with a complete line of military peripheral circuits, synchronous and asynchronous storage and RAM for working storage. The I/O circuits are field programmable so that addressing of the microprocessor may be set by the user.

The 8X300 operates from a single 5-volt power supply which can be strobed for power savings in extreme environments and under

MERLIN

THE INTELLIGENT VIDEO INTERFACE

MERLIN is the best ASCII/Graphics board now available for the S-100 bus . . . and at an unbelievable price!

Compare these features to any other video interface:

- ☆ 160H x 100V resolution bit mapping graphics
- ☆ On-board ROM (Monitor/Editor) option
- ☆ 40 characters by 20 lines, character ROM generated (hardware)
- ☆ Keyboard interface (with power)
- ☆ Programmable modes and display format
- ☆ Serial I/O port
- ☆ Low power . . . only 600ma at +8V
- ☆ Extremely fast (uses DMA)
- ☆ Comprehensive User Manual . . . 200ps
- ☆ American 60HZ or European 50 HZ operation.

Designed-in expandability means maximum versatility at minimum cost. Add-on options now available (in kit form) include:

- ☆ Super Dense Graphics (M320-K) \$39
- ☆ Lower case characters (LC) \$25
- ☆ Serial-to-parallel expansion Kit (MSEK-K) \$45
- ☆ 1500 Baud (software) cassette interface kit (MCAS-K) \$29
- ☆ 2K x 8 Mask ROM; graphics, cassette, & extended editing software (MEI) \$35
- ☆ 2K x 8 Mask ROM/256 RAM; Monitor Editor Software (MBI) . . \$39

The MBI ROM software is designed to allow turnkey operation and sophisticated editing and scrolling.

Ask to see a demonstration of MERLIN at your nearest computer store. Many dealers now stock MERLIN and there is nothing like a hands-on demo for really evaluating a product. We know you'll be sold.

MERLIN Kit with Manual \$269
MERLIN, assem'd & tested \$349
MERLIN User Manual \$ 10

For fast information, write us direct!
MC and BAC accepted.



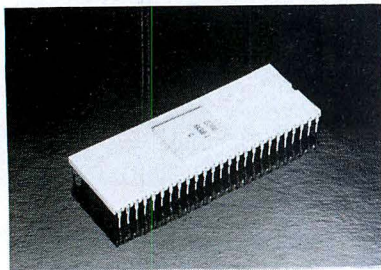
MiniTerm Associates, Inc.

Box 268, Bedford, Mass. 01730 (617) 648-1200

CIRCLE INQUIRY NO. 28

tight system constraints.

Program storage can be provided by a variety of PROMs, such as the 2K 82S131, and the 4K 82S115 or 82S137. Working storage is provided by RAMs such as the 82S16, 82S11, or 82S09.



The operational simplicity of the 8X300 con-

siderably reduces the complexities of designing the microprocessor into hardware, according to Signetics. The system designer need only select a program storage device (ROM, PROM, etc.), the I/O devices (IV Byte, Multiplexers, RAM, etc.), the clock mode (system driven or crystal controlled), and interface the 8X300 to these components. For further information, contact Signetics, 811 East Arques Ave., Sunnyvale, CA 94086, (408) 739-7700.

CIRCLE INQUIRY NO. 114

Mini Word Processing System

A Mini Word Processing System running on MITS Altair equipment under Disk Extended Basic is available for just \$150.00. Mini Word Processing is designed to help an operator generate letters, text and mailing labels or envelopes. The system consists of seven pro-

grams which are driven by a menu select routine from which any of the seven processing programs can be utilized. Each program interacts with the operator to establish file names and drive numbers. The options are selected by the operator using simply Y or N (Yes or No) responses to the detailed program prompts. After each function is completed the System reloads the menu routine.

A complete Users Manual consisting of 51 pages is provided with the System. The manual includes detailed instructions concerning all operator prompts, and system error messages, a number of examples with test data, and programming considerations for custom applications.

For further information, contact the Software Store, 706 Chippewa Square, Marquette, Michigan 49855. (906) 228-7622.

CIRCLE INQUIRY NO. 115

Microcomputer Systems

New Turnkey Version Features Power-On-Start

The Altair 8800b Turnkey computer incorporates the quality construction and good looks of the Altair 8800b computer in addition to such new features as power-on-start, which allows automatic program execution as soon as the power is turned on.

With the new Turnkey Module board, all the functions units of the computer—the CPU, RAM and PROM memory, sense switches and serial I/O—are contained on just one circuit board, which is supplied in the standard Turnkey version package. However, the system has the same expandability as the full front panel

model 8800b computer. All hardware for the full front panel Altair 8800b computer is compatible with the Altair 8800b Turnkey model.

The Turnkey Module consists of a serial I/O channel that can operate with a variety of peripheral devices, 1K byte of RAM, provisions for 1K byte of PROM and logic for the power-on-start feature.

Available software includes a PROM-resident multipurpose bootstrap loader and a monitor PROM. Since the 8800b Turnkey system is completely software compatible with the Altair 8800b computer, it can use the full complement of Altair system software.

The front panel has a key-lock power switch which prevents accidental or unauthorized

turn-on or turn-off.

The front panel also has indicators for HALT, I/O transfer, interrupt request and interrupt enable; and switches to actuate the power-on-start function and to RUN or STOP program execution.

The Altair 8800b Turnkey computer system is particularly well suited for dedicated applications but also provides simple, cost-effective general purpose computer. For further information, contact MITS, 2450 Alamo S.E., Albuquerque, N.M. 87106.

CIRCLE INQUIRY NO. 116

WHAT'S A BOPA?

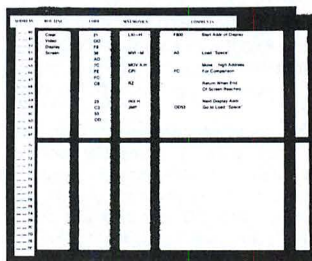
ADDRESS	ROUTINE	CODE	MNEMONICS	COMMENTS
— 60	Clear	21	LXI—H	F800 Start Addr of Display
— 61	Video	00		
— 62	Display	F8		
— 63	Screen	36	MVI—M	A0 Load "Space"
— 64		AO		
— 65		7C	MOV A,H	Move high Address
— 66		FE	CPI	FC For Comparison
— 67		FC		
— 68		C8	RZ	Return When End
— 69				Of Screen Reached
— 6A		23	INX H	Next Display Addr.
— 6B		C3	JMP	OD53 Go to Load "Space"
— 6C		53		
— 6D		OD		
— 6E				
— 6F				
— 70				

Close-up of Board

ORDER CODE:

BOPA—1	Single card system	\$11.95
BOPA—4	Four card system with 128 entries, pen, and Solvex-80 cleaning solution	\$39.95
BOPA—8	Complete system with 256 entries, pen, Solvex-80.	\$74.95
PNS	Special ink pen.	\$ 1.00
SLX	Solvex cleaning Sol'n., 1 1/4 oz.	\$ 1.25

MIN. ORDER \$5. — Calif. Residents add 6% Tax.
For orders less than \$15, add \$1 for shipping.
Foreign orders add 50¢ per board (U.S. Funds Only).



It's a Basic Operating Programming Aid, a new and revolutionary microcomputing aid to help you write machine level programs faster and more accurately.

— FEATURES —

- ★ You write on movable slats.
- ★ 32 memory addresses per board.
- ★ You assign the memory range.
- ★ Automatically reassigns addresses as you edit.
- ★ Compiles and assembles programs quickly.
- ★ 4 columns, ROUTINE, CODE, MNE., COMMENTS.
- ★ Reduces Programming Time.
- ★ Machine level programming is a snap.
- ★ Program anywhere, it's portable.
- ★ Re-usable, unbreakable mechanism.
- ★ Corrections are quick and easy.
- ★ Excellent learning aid.
- ★ Fits 3 ring binder (9" X 11" X 3/16").
- ★ Completed programs can be xeroxed.

See It At Your Local Computer Store.

VAMP INC.
P.O. Box 29315
Los Angeles, CA 90029

POLY 88 System Sixteen

A ready to run system, the POLY 88 System Sixteen lets you solve those home financing problems, perform a statistical analysis, or enjoy a host of challenging games. The 16K system features a high-speed video display and an alphanumeric keyboard. Cassette tapes are used for permanent program storage.



Programming is made simple by the BASIC software package. PLOT and TIME are two of the unique features which rely on our video graphics and real-time-clock. Other features include VERIFY so that you know that your tape is good before you load another. Scientific functions, formatting options, and string capabilities are also included. In addition to the programs written by the user, the POLY 88 program library makes a growing number of applications available to the POLY 88 owner. System Sixteen \$2250.00, Kits start at \$735.00. For further information, contact: PolyMorphic Systems, 460 Ward Drive, Santa Barbara, CA 93111.

CIRCLE INQUIRY NO. 117

RD 11

The RD11 is a low cost, desk size computer utilizing the popular LSI-11 central processing unit manufactured by Digital Equipment Corporation. The LSI-11 emulates the PDP11/40/34 instruction set and is compatible with a wide range of standard Digital software.



The RD11 features static MOS or core memory, a direct memory access interfaced floppy disk system and an extensive selection of peripherals. (Cartridge disc, magnetic tape, card reader/punches, paper tape and word processing printers, etc.). Software offered includes Digital's RT11 Operating System, full macro-assembler, Fortran IV, Multi-User Basic, Focal and APL.

In addition to the desk model shown, the RD11 is available in a roll-around desk high enclosure or a full size electronic equipment rack.

A representative system with 56,000 bytes of static memory, fixed and floating point arithmetic, dual 1.2 megabyte floppy disc, 24 line video display console, 120 cps line printer, enclosure and RT11 Operating System is priced at \$14,650. Delivery is 30 days. For additional information contact: W. R. Davies, RDA, Inc., 5012 Herzel Pl., Beltsville, MD 20705, (301) 937-2215.

CIRCLE INQUIRY NO. 118

Vector 1 +

The Vector 1+, ideal for business applications, has provisions to incorporate a Shugart mini-floppy or an exact equivalent.



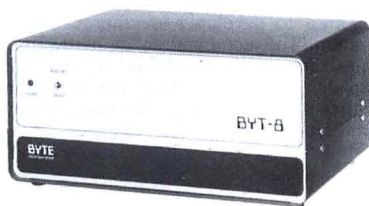
Provides load and store programs within seconds. Starting at only \$389 you get the masterfully designed custom cabinet in either Vector Graphic Green or Burnt Orange, an 18-slot, fully shielded motherboard, S-100 bus, 6 connectors, a power supply 18A, 8V; 2.5A, $\pm 16V$. A whisper fan and a power supply card to modify the Shugart drive are also included. In addition you may purchase the 8080 based CPU board with 8 level vectored interrupts and a real time clock. A unique PROM/RAM board with 1K of RAM and room for 2K of PROM with a 512 byte resident monitor programmed on 2 1702A PROMs designed for an I/O board of your choice is also available. The unit requires an I/O board and a terminal or video board, keyboard and a monitor.

Contact us for further details, Vector Graphic Inc., 790 Hampshire Road A-B, Westlake Village, CA 91361, (805) 497-0733.

CIRCLE INQUIRY NO. 119

BYT-8 Computer

Byt-8 offers complete flexibility of configuration for a customized computer system.



The basic unit at \$229 has a metal chassis with rear panel control of power On/Off. Operator control from the front panel includes Start/Restart and a power on indicator. Internally, ten circuit cards may be plugged into the ten slot motherboard, which is S-100 bus compatible. The motherboard provides the circuitry for a real time clock and +8 volt 10 amp, ± 18 volt 1.5 amp unregulated power supply.

The Byt-MPU processor board at \$120 is a S-100 bus compatible 8080A microprocessor card. On board regulation of +12 volts and ± 5 volts allows for isolated distributed power throughout the system. All signals to and from the bus are tri-state buffered. The 5" x 10" circuit card also offers a crystal controlled clock and the feature of 8 level vector interrupt at the user's option, by inserting a 8214 chip into the socket provided. The real time clock pulse is already available on the bus of the Byt-8.

For further information, contact Byte Incorporated, 1261 Birchwood Dr., Sunnyvale, CA 94086.

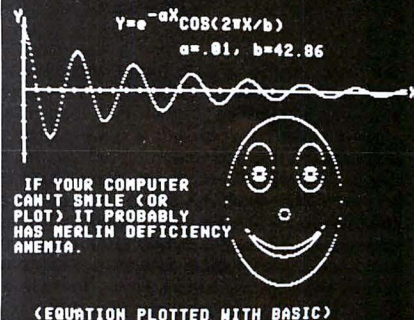
CIRCLE INQUIRY NO. 120

BYT-CP

The Byt-CP control panel at \$189.95 is a S-100 bus compatible board that allows full operator control of the computer from the front

SUPER DENSE GRAPHICS

320 Horizontal by 200 Vertical



The MERLIN Super Dense add-on kit provides maximum resolution at a minimum cost. In fact, MERLIN with Super Dense has more capabilities than any other S-100 bus video interface at any price!

Once you've seen 'Super Dense' graphic resolution you'll know there is nothing to compare it to . . . short of spending over \$600 . . . and even then you'll not have all of the capabilities of MERLIN with 'Super Dense'.

Super Dense provides true bit-mapping. Each and every point on the screen is controlled directly by a bit in memory. (Requires 8K of system memory.)

ROM character-graphics looked good for a while; then came MERLIN's 160 by 100 bit mapping graphics; and now . . .

320 by 200 bit-mapping graphics!!

If you're looking for a graphic display, MERLIN with Super Dense is the best there is. And if you hadn't considered graphics or thought it was out of your price range, consider what you could do with 320 H by 200V graphics and for only \$39 extra.

The Super Dense add-on kit to the popular MERLIN video interface is now available with off-the-shelf delivery.

M320-K, Super Dense Kit . . . \$39

M320-A, Super Dense Assem. . . \$54

See MERLIN ad on previous page.

For information fast, write direct, or see 'Super Dense' at your nearest computer store.

MC and BAC accepted.



MiniTerm Associates, Inc.

Box 266, Bedford, Mass. 01730 (617) 648-1200

CIRCLE INQUIRY NO. 28

panel. Front panel light emitting diodes (LED) indicate 16 bits of address, 8 bits of machine state, 8 bits of data, 8 bits of CPU status, 8 bits of output and power on.



Switch control of 8 data bits, 8 input bits, 16 address bits, deposit, deposit next, examine, examine next, protect, not protect, reset, clear, stop, run, single step and a unique stop on compare of the address selected by the address switches. The 5" x 14" circuit card has on board regulation of +5 volts and signals are tri-state buffered. The card occupies the first connector slot on the Byt-8 motherboard with matching front panel. However, it may conveniently be used with an extender board in any S-100 bus computer system.

For further information, contact Byte Incorporated, 1261 Birchwood Dr., Sunnyvale, CA 94086.

CIRCLE INQUIRY NO. 121

Micral C, A D.P. System

R2E, the French microcomputer manufacturer will introduce at the NCC show (Dallas Convention Center, Booth No. 53, June 13-16), MICRAL C, a data processing system, compact, lowcost and powerful.



In this age of microcomputers, R2E goes still further with the MICRAL C which, for a much lower cost, offers all the possibilities and performances of a larger system at the price of a small copying machine. The MICRAL C can perform various operations in the d-p, accounting, administrative and educational fields. In addition, the MICRAL C can be used as a word processor, automatic typesetting and other operations in this field.

The MICRAL C consists of a powerful CPU (24,32 up to 64 K bytes of RAM), a VDU (1 920 c.) and keyboard station where two MINIFLOPPIES offering 160 K bytes on-line are integrated. Various types of printers can be connected to this compact unit.

Service companies selling computer processing time can propose MICRAL C to their clients as a multi-purpose stand alone system for data acquisition and consultation of small files. Price of base configuration, \$8,000.

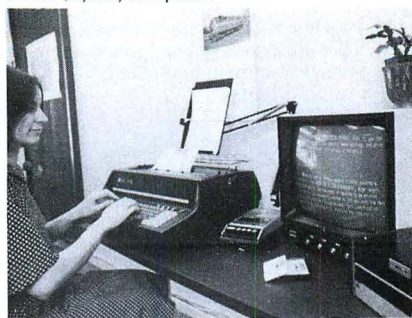
For further information, contact Réalisations Études Électroniques, Zone D'activités de Courtaboeuf, Avenue de Scandinavie, bp 73 91403 Orsay, 907 47 77.

CIRCLE INQUIRY NO. 122

A Real Word Processor

Computer Power & Light, Inc. is pleased to announce the first commercial quality, microcomputer based word processing system for

under \$6,000, complete.



Based on the field proven COMPAL-80 computer and Xerox Corp.'s Diablo 1620 daisy wheel printer, it contains features found only on systems costing \$20,000 or more. Among these are: complete text editing on a large CRT; insertion or deletion of text, and the ability to move blocks of text anywhere; variable speed scrolling of entire text on the CRT, forwards and backwards; ability to search for all occurrences of a specific word or group of words and replacement with alternative word or words; storage and retrieval of finished text on low-cost Phillips audio cassettes at the rate of 240 characters per second; a variety of printing options, including variable line length, 1-5 spaces between lines, variable character spacing, presettable page headings, page numbering, and right and left margin justification using the Diablo's unique character spacing routines—no extra blanks are inserted in your text, nor is there any need for hyphenation. This potent system is available only at Computer Power & Light, 12321 Ventura Blvd., Studio City, CA or 7878 Clairemont Mesa Blvd., San Diego, CA. Four lease plans and bank financing are available. Call (213) 760-0405 for more information.

CIRCLE INQUIRY NO. 123

F8 Formulator Mark III

The top of the line in microprocessor development equipment is the F8 Formulator Mark III, offering all of the design assistance required to develop a microprocessor-based system. The combination of hardware, software, and firmware offered by the Mark III assists the designer from the generation of source programs through the development of a prototype system.



The Mark III is a modular microcomputer that accommodates a variety of memory, input/output, and communication configurations to form a new and powerful development system. It contains all of the components of the Mark II — the Processor Module, card case and motherboard, cable kit, the Fairbug Monitor ROM, 16K bytes of RAM, and the Formulator Operating System (FOS). Like the Mark II Formulator Operating System, the Mark III FOS consists of a monitor, an editor, an assembler, a linking loader, a debug package, and several utility programs. In addition to the functions performed by each of these portions of the FOS in a Mark II system, the Mark III FOS includes the capability to set hardware breakpoints.

It also contains a trace feature in the debug package which lets the user turn tracepoints on and off during the debug operation. Addi-

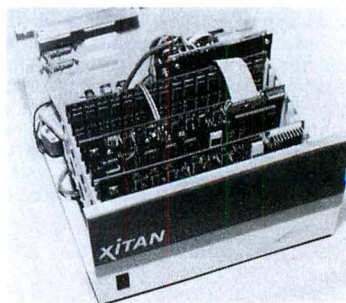
tional hardware components of the Mark III system include a Quad I/O Module with four I/O ports and two interrupts, a Communications Module with an on-board UART, a Universal Breadboard for building user hardware configurations, an Extender Module, and an intelligent operator's panel. Power supplies for the Mark III may be either 100 volts, 115 volts, or 220 volts at 50/60 Hz. Peripheral interfaces are available to connect the Mark III with a TI Silent 733, a Teletype ASR33, or an HP 2645A Mini-Data Station.

For further information, contact Fairchild Microcomputers, 1725 Technology Dr., San Jose, CA 95110, (408) 998-0123.

CIRCLE INQUIRY NO. 124

TDL XITAN Computer System

Living up to their reputation as "The Design Leader in Computers," Technical Design Labs has produced an exciting and powerful Z80 computer system named the XITAN. The prolific Princeton firm markets the XITAN (pronounced "ZY-TAN") in two configurations: The XITAN *alpha 1* and the XITAN *alpha 2*. There has never before been such computing power in such small space.

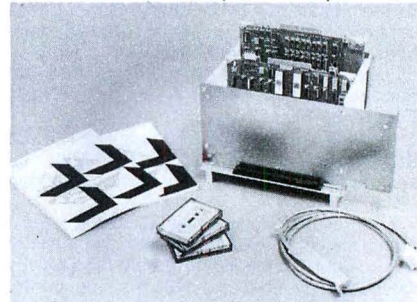


Both XITAN *alpha* systems are housed in rugged .092 aluminum boxes containing up to 8 slots for system expansion to a full 64K with DISK, LINE PRINTER, etc. Following the addition of their own I/O device, users will have the most powerful and flexible microcomputer package ever offered. All Technical Design Labs equipment is made to the continuing high standard which distinguishes the firm in the industry. XITAN *alpha 1* in kit form sells for \$769, and for \$1,037 assembled and tested. The XITAN *alpha 2* kit is \$1,369, and is \$1,749 assembled and tested, complete with software. Write for information: Technical Design Labs, Research Park, Bldg. H, 1101 State Road, Princeton, N.J. 08540, (609) 921-0321.

CIRCLE INQUIRY NO. 125

F8 Formulator Mark II

The F8 Formulator Mark II is a low cost microcomputer software and hardware development tool. It includes the basic hardware required by users who need to develop a system, as well as the necessary software tools for users to develop microcomputer code.



The Mark II consists of all of the components of the Mark I, namely the Processor Module, card cage and motherboard, cable kit, and the Fairbug Monitor ROM, as well as an additional 16K Byte RAM Module. Also a part of the Mark II is the Formulator Operating System (FOS), a

software package specifically designed to assist engineers and programmers during the development phase of a microcomputer-based system. FOS consists of a monitor, an editor, an assembler, a linking loader, a debug package, and several utility programs which together allow the user to generate F8 source code and create and check out F8 object code. Peripheral interfaces are also available to connect the Mark II to a TI Silent 733 or Teletype ASR33.

For further information, contact Fairchild Microsystems, 1725 Technology Dr., San Jose, CA 95110, (408) 998-0123.

CIRCLE INQUIRY NO. 126

NOVAL 760 Personal Computer

This 8080 based microprocessor system is aimed at the software hobbyist, small business and color graphic game applications.

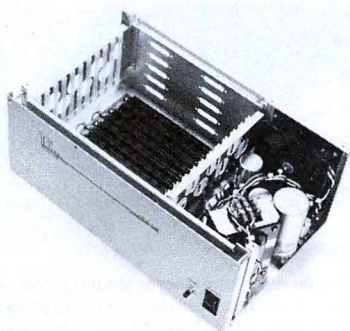


Fully assembled into an attractive desk, it fits well in a living room or study environment. Minimum configuration includes full keyboard, 12" B/W display, magnetic tape unit, matrix printer, development software, graphics software, 16K RAM memory, tone generator and three general purpose I/O connectors. Among numerous options are BASIC, additional 16K RAM, development software and BASIC on PROM, I/O cards, UART card, color display, dual (one alphanumeric and one graphic) display and dual small keyboards for competitive games. Configuration shown: \$2995.00 FOB San Diego. Comprehensive Operating Manual: \$20.00. For price sheet and ordering information write: NOVAL Inc., 8401 Aero Drive, San Diego, CA 92123.

CIRCLE INQUIRY NO. 127

The Mainframe

THE MAINFRAME is a foundation unit for a microcomputer system consisting of a heavy duty aluminum cabinet, finished in TEI blue and vented for most efficient airflow.



The power supply consists of a constant voltage transformer providing brownout protection and showing a very high immunity of input to output noise, better than 100 db. The power supply is designed to meet UL specifications and is complete with primary and secondary voltage fuse protection. The power supply is rated at 17 amps at 8 volts and at 2 amps plus or minus 16 volts. The motherboard is a 12-slot S-100 bus system furnished with all edge connectors inserted, soldered and checked out. No soldering is required. Fully compatible with all S-100 bus type PC boards.

The front panel includes an indicating AC

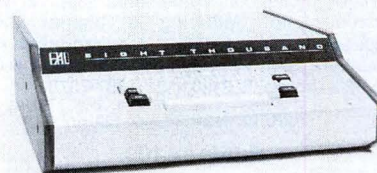
switch and a reset switch but the unit is also designed to accept the TEI "Virtual Operating Console" front panel which will soon be available.

A 115 CFM muffin fan with a commercial grade washable filter is furnished to provide a clean airflow. All wiring is pre-cut and pre-lugged for ease of assembly. Supplied either as a kit or assembled, specify Model MCS-112-K for the kit or Model MCS-112-A for the assembled unit. For more information contact, CMC Marketing Group, 7231 Fondren Road, Houston, TX 77036, (713) 774-9526.

CIRCLE INQUIRY NO. 128

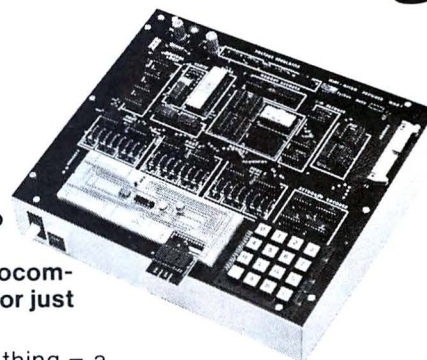
HAL Eight Thousand Microcomputer System

The HAL EIGHT THOUSAND is a fully assembled microcomputer system with video output for use by the hobbyist, in small business operations, or for a wide variety of dedicated applications.



Prices range from a 2K RAM system at \$1195.00 to \$1750.00 for a 16K RAM system with Dual Audio Cassette Interface. Supplied with each 9K or 16K RAM system is HAL TTY BASIC (3K) on audio tape (Kansas City Standard). Also available is HAL Floating Point Basic, which uses approximately 8K of RAM. These Basic tapes make the Eight Thousand

Mini-Micro. Maxi Savings.



The Mini-Micro Designer – a complete microcomputer system for just \$830.50!*

Here's the real thing – a microprocessor that takes you right to "real world" situations for about half the price of other systems.

With our hardware, you'll receive the most complete software package in the business. 700 pages of clear instruction, written by Rony, Larsen, Titus – famous for their BUGBOOKS®. Designed to show you how to get your MMD-1 up and working even if you have no prior knowledge of digital electronics.

With our MMD-1 and M/I board combination you'll get all of the interfacing hardware you need, without costly extras.

*Suggested resale price (U.S.A.).

Here's what we pack in for \$830.50:
2.5K RAM ... 1.5K PROM (special D-Bug, Monitor and Keyboard Interpreter) ... Audio Cassette Interface ... TTY Interface ... Built-in Keyboard for Control and Data Entry ... Direct Access to latched ports ... Built-in Breadboarding Capability ... Single Step Option ... Monitors for Address and Data Busses. And more.
Best of all, it's on the shelf at your computer store now. Write us for an info-packed brochure and the name of the dealer nearest you.

Dealer inquiries invited.



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(203) 735-8774 Telex No. 96 3536

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one of the best bargains on the market. The HAL System Monitor (supplied in ROM) makes machine language programming easier to live with for those concerned about special applications not requiring a higher level language. Write or call HAL today for more information. HAL Communications Corp., P.O. Box 365, Urbana, IL 61801, (217) 367-7373.

CIRCLE INQUIRY NO. 129

Equinox 100

A small "personal computer" now offers front panel control exceeding virtually any other system.

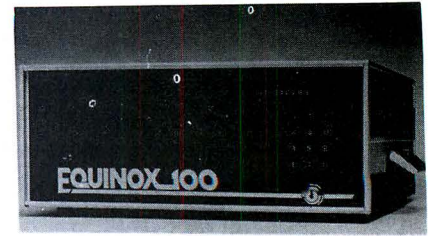
Almost deceptively simple, compared to the complex arrays of binary lights and toggle switches on most mainframes, the Equinox 100 console features a 12-pad keyboard and numeric 7-segment LED display.

Behind the plexiglass on inventor/designer G. Morrow's integrated CPU/front panel board, lies powerful new "firmware" that gives Equinox 100 remarkable capabilities. Working on the front-panel keyboard and display, the operator can monitor or alter any register, register pair, memory location or I/O device in the system.

Equinox 100, an under-\$700 8080-based mainframe kit, can single-step through programs, Slow-Step™ at a programmable rate from 1 to 64K steps per minute, or HALT at predetermined points without "going to sleep."

Busboards, front panel boards and other Equinox 100 components will be sold separately by Thinkertoys, a combined sales organization of Parasitic Engineering and Morrow's Micro-Stuff. Most Equinox-100 components are fully compatible with other mainframes

utilizing S-100 bus systems.



For further information, contact, Howard Fullmer, Parasitic Engineering, P.O. Box 6314, Albany, CA 94706, (415) 547-6612.

CIRCLE INQUIRY NO. 130

Peripherals

4800 BPS Microprocessor Modem with Industry's Fastest Acquisition Time

The 48 MICRO data modem operates at 4800 bps for use on point-to-point leased lines, multipoint leased lines, and the dial network. Penril's 48 MICRO data modem incorporates a 12-bit microprocessor for adaptive equalization, provides comprehensive diagnostics, meets European CITT requirements, and its Fast Poll feature offers the fastest acquisition time in the market place.



The self-contained 12-bit microprocessor of the 48 MICRO uses digital processing techniques for adaptive equalization, realizing the mean square algorithm, carrier recovery, and data detection. A Fast Poll option is available on the multipoint version of the modem to minimize synchronization of the receiver. In this mode, design techniques permit a 14 millisecond Request to Send and Clear to Send delay. This is the fastest acquisition time available from any modem manufacturer to date.

Comprehensive diagnostic features that do not require operator assistance at the remote end are available in the 48 MICRO. These features allow checking of segments of the communications system using test patterns from the modem's built-in pattern generator. These diagnostics include: (1) analog loopback to test the local modem, (2) line loopback to test the local modem and telephone line, and (3) digital loopback to test the local modem, telephone line, and remote modem. Remotely controlled end-to-end testing and anti-streaming shutdown are included in the diagnostic capability. A full-duplex 110 bps asynchronous secondary channel is used for transmission of diagnostic commands. The secondary channel is also available as an option for modems not supplied with remote diagnostic capability.

For further information contact, Penril Corp., 5520 Randolph Rd., Rockville, MD 20852, (301) 881-8151.

CIRCLE INQUIRY NO. 131

Sophisticated Mass Storage for Microcomputers

Recognizing the need for low-cost versatile mass storage for Altair-type 8080 based microcomputers, Micro Designs is offering two new digital cassette mass storage systems with up to one megabyte capacity.



An integral part of these ready-to-use systems is their complete file management software which allows the user to manipulate both symbolic and binary files with high-level commands.

The Micro Designs Model 100, a compact unit with a single cassette drive, stores one-half megabyte of data. The disk-like format of the data on the tape allows access to any single 128 byte record. The data transfer rate is 1000 bytes per second, and the tape may be searched at a rate exceeding 120 inches per second. The dual transport Model 200 puts one megabyte on line.

Both units come fully assembled, and ready for immediate use. The supplied interface board plugs into the main frame motherboard connector to attach the mass storage unit to the computer. To bring up the operating system, the user loads a cassette, and transfers control to the ROM on the interface board; all further tape operations are automatic. Status lights inform the user of relevant tape conditions, and hardware error detection is provided.

These small table top units sell for \$600 (Model 100) and \$875 (Model 200). Delivery is 30 days. For further information contact: Micro Designs, Jim Zeitlin, 499 Embarcadero, Oakland, CA 94606, (415) 465-1861.

CIRCLE INQUIRY NO. 132

Artisan Microcalculator Model 85

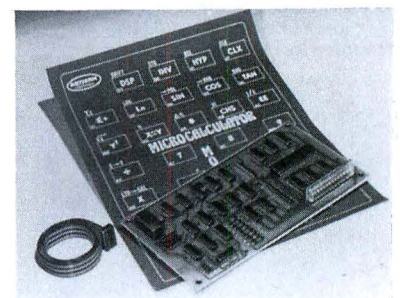
The microcalculator, Model 85, is intended for operation with 8-bit microprocessors. The Model 85 requires only + volts for operation and interfaces with the microprocessor through an 8-bit bi-directional I/O port.

Direct interface with most 8-bit peripheral in-

terface devices such as the Motorola 6820, Mostek 3820, Mos Tech. 6530, Intel 8255 and others. Each entry that would normally be made by a key is replaced with an 8-bit instruction from the microprocessor. The number of input instructions is not limited, restricted only to the user program or the amount of memory in the microprocessor system.

Instruction entry to the microcalculator Model 85 is under microprocessor software control. The Model 85 accepts instructions, provides a means to detect busy status, an output the full fourteen display back to the microprocessor for storage or display.

The Model 85 has scientific calculation capabilities for handling scientific, engineering, mathematical or statistical problems. It contains four register stack with nine memory registers. Problem solving capability includes transcendental functions, such as logarithms, sines and tangents; polar/rectangular coordinate conversions for handling complex arithmetic, vector; multiple storage registers, selecting operating mode and also constants for "pi" and "e" are provided — as well as four metric/U.S. unit constants for conversions between Cm/in, Kg/Lb, Ltr/Gal, C°/F°. Moreover, statistical capabilities for calculating the mean and standard deviation are provided.



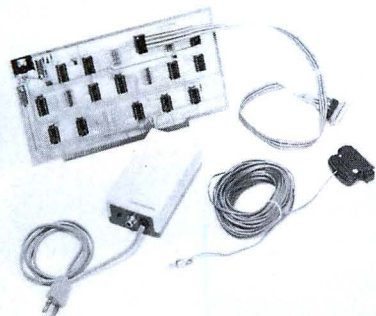
With the aid of the microcalculator Model 85 and the microprocessor, an advanced programmable scientific calculator system may be achieved. Price \$189.00; Delivery stock to three weeks. For more information contact Alan Seman, Artisan Electronics, 5 Eastmans Road, Parsippany, N.J. 07054.

CIRCLE INQUIRY NO. 133

A Power Control System for the Serious User

PC3200 Power Control System is a series of components that opens up countless new applications for S-100 bus microcomputers. The system components combine to form a high quality AC power switching system that

enables microcomputer control of lights, small motors, appliances, tools, etc. All components are designed around a system concept developed to meet the most demanding applications — from personal systems through light to medium industrial control applications.

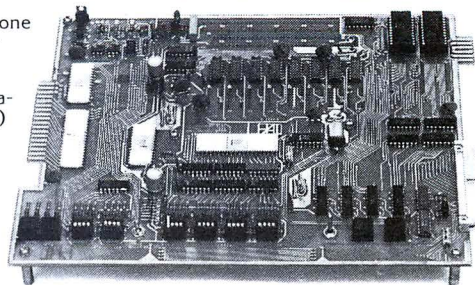


Because real world power control applications are obviously external to the microcomputer, power switching devices should also be externally located. This eliminates lengthy runs of AC power cabling both to and through the microcomputer chassis. The PC3200 System allows this type of distributed control by offering Control Logic Interface (CLI's) on S-100 compatible circuit boards, and Power Control Units (PCU's) that can be remotely located at the desired point of control. Control outputs from the CLI's are safe, low voltage, current limited signals that are routed to the various PCU's. Optical isolation is provided at both ends of the control signal, providing maximum noise immunity and short circuit protection.

Control Logic Interfaces contain up to 32 independently addressable control channels, yet require only one output port address. A single byte output from the processor selects an individual channel, and turns it on or off without affecting the state of any other channels. Program control of PC3200 channels is straight-

If you want a microcomputer with all of these standard features...

- 8080 MPU (The one with growing software support)
- 1024 Byte ROM (With maximum capacity of 4K Bytes)
- 1024 Byte RAM (With maximum capacity of 2K Bytes)
- TTY Serial I/O
- EIA Serial I/O
- 3 parallel I/O's
- ASCII/Baudot terminal compatibility with TTY machines or video units
- Monitor having load, dump, display, insert and go functions



- Complete with card connectors
- Comprehensive User's Manual, plus Intel 8080 (User's Manual)
- Completely factory assembled and tested—not a kit
- Optional accessories: Keyboard/video display, audio cassette modem interface, power supply, ROM programmer and attractive cabinetry... plus more options to follow. **The HAL MCEM-8080. \$375**

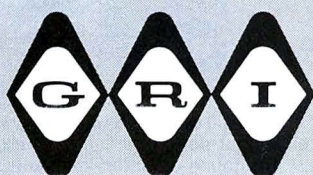
...then let us send you our card.

HAL Communications Corp. has been a leader in digital communications for over half a decade. The MCEM-8080 microcomputer shows just how far this leadership has taken us...and how far it can take you in your applications. That's why we'd like to send you our card—one PC board that we feel is the best-valued, most complete



microcomputer you can buy. For details on the MCEM-8080, write today. We'll also include comprehensive information on the HAL DS-3000 KSR microprocessor-based terminal, the terminal that gives you multi-code compatibility, flexibility for future changes, editing, and a convenient, large video display format.

HAL Communications Corp.
Box 365, 807 E. Green Street, Urbana, Illinois 61801
Telephone (217) 367-7373



Professional Keyboard Kit



LOW COST! Model 753 ASCII Keyboard Kit or Assembled

- 53 Keys, popular ASR-33 format
- Rugged G-10 P.C. Board
- Tri-mode MOS encoding
- Two-Key Rollover
- MOS/DTL/TTL Compatible
- Upper Case lockout
- Data and Strobe inversion option
- Three-User Definable Keys
- Low contact bounce
- Selectable Parity
- Custom Keycaps • MORE!



Optional keyboard enclosure

Durable enclosure made of long-lasting ABS plastic, custom fit for the Model 753. Complete with all hardware. Color: Medium grey.

Pricing Information

Model 753 (Assembled)	\$71.25
Model 753K (Kit).....	59.95
Model 701 Enclosure.....	14.95

For Quantity Prices, Contact GRI Direct.

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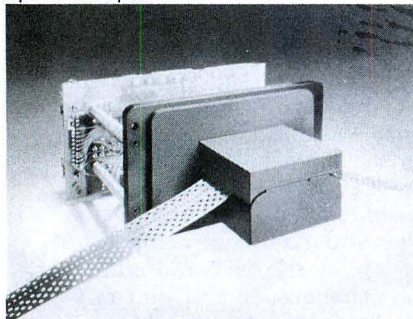
forward, and in most systems can be accomplished with a single BASIC statement.

Three PC3200 System components are presently available — the PC3232, a 32 channel Control Logic Interface (\$299 kit, \$360 assm.), the PC3216, a 16 channel Control Logic Interface (\$189 kit, \$240 assm.), and the PC3202, a 400 Watt 120 VAC Power Control Unit (\$39.50 kit, \$52 assm.). Additional models will be announced as they are available. For further information, contact COMPTON, P.O. Box 516, La Canada, CA 91011.

CIRCLE INQUIRY NO. 134

Punched Tape Strip/Loop Reader

Designed for microprocessor software development, PROM programmers, photo-typesetting and machine control applications, EECO's new 2001-2 Reader reads punched tape at 150 cps.



EECO's 2001-2 is TTL compatible and reads any commercially available punched tape. The read head opens wide for easy loading. A new read head design provides for reduced read errors due to out of tolerance and skewed tape. Constructed of a high wear resistant material, the read head will not built up static electricity which can cause data errors.

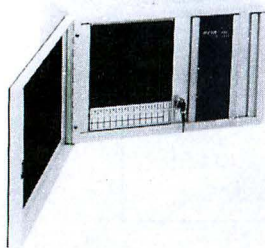
2001-2 is only 3.16" (80.3 mm) high and 6.44" (163.6 mm) wide. It requires only 3.88" (98.6 mm) behind panel depth including connectors. The read head extends 2.10" (53.3 mm) in front of the panel.

EECO, 1441 East Chestnut, Santa Ana, CA 92701. Phone "Tape Readers" (714) 835-6000.

CIRCLE INQUIRY NO. 140

Computer Port Expander

A Computer Port Expander has just been introduced which permits 2-29 nonpollable terminals each to be connected to one of 1-15 computer ports. The new Expander, designated MICOM 602, offers a maximum complement of 30 terminals and ports.



In operation, a customer-selected predefined ASCII character (typically, Carriage Return) initiates a connection. If a port is available, the character, known as a Terminal Connection Request (TCR), is passed to the computer and a transparent link is established and maintained until the transaction is complete. The transaction is terminated either by customer-defined timeout or when a predefined End of Transaction code is received from the computer.

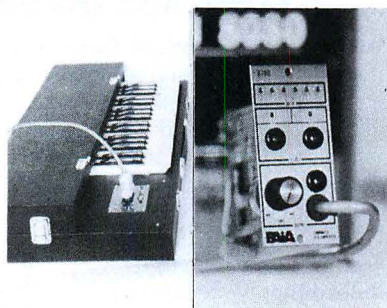
The hardware used in Micom's new 602 Computer Port Expander is the MICOM 40 Series Communications Processor, with the system program implemented in firmware and residing in two 1024 byte (8 bit) PROM's located on the Central Control Module. Single and dual asynchronous line interface modules with programmable speed selection for any terminal or port speed up to 9600 bps are used to interface to the computer ports and terminals.

The 602 unit is priced from \$3,000, with delivery currently scheduled at 45 days. For further information on the Expander, phone or write Micom Systems, Inc., 9551 Irondale Ave., Chatsworth, CA 91311, (213) 882-6890.

CIRCLE INQUIRY NO. 135

Computer Music

The PAIA 8780 Digital to Analog converter and the 8782 Encoded Keyboard both easily interface to any processor providing capabilities and control never before possible with music synthesizers.



Unlike more conventional R-2R ladder type digital to analog converters the 8780 D/A kit is based on a multiplying principle that allows the module to generate the exact exponential stair-step function required to make even the simplest linear response oscillators and filters produce equally tempered musical intervals. The 8780 uses only six bits of data to generate over 5 octaves of control voltage. In an 8-bit system, the remaining 2 bits are ordinarily reserved for trigger flags, but may be used to extend the range of the converter or provide micro-tonal tunings. Compatible with the complete line of PAIA music synthesizer modules and easily interfaced to any microprocessor with or without hand-shaking logic the 8780 is priced at only \$34.95.

The 8782 encoded keyboard contains an n key roll-over scanning matrix encoder tied to a 37 note AGO keyboard and provides 6 bits of data and both STROBE and STROBE control outputs. Input control lines to the encoder include SCAN (starts and stops the encoder clock), RESET, START, and RANDOM making the keyboard universally applicable to all computer/processors from the very largest to the very smallest. The Encoded Keyboard kit includes all parts including keyboard and power supply and a trim and sturdy vinyl covered road case at a cost of \$109.95 (shipped freight collect — 20 lbs.). Both kits include well-illustrated step-by-step assembly instructions. Software overview for computer applications and detailed instructions for digital sample and hold applications. Available from PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116. A free catalog will be sent upon request.

CIRCLE INQUIRY NO. 136

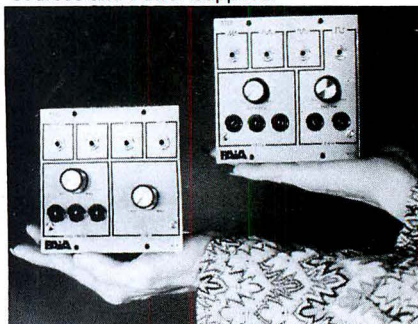
Music Synthesizer Modules

PAIA offers a complete line of low-cost voltage controlled music synthesizer module kits including the 4720 Oscillator and 4730 filter shown. Both units feature linear freq./control voltage response and 16 Hz to 16 kHz range.

The 4720 VCO produces ramp, triangle, sine and pulse waveforms. The companion 4730 VCF is a state variable design with simultaneously available low-pass, band-pass and high

pass outputs, all with "Q" adjustable from .5 to 150.

Other modules in the series include: Voltage Controlled Amplifiers, Balanced Modulators, Envelope Generators, Reverb Units, Noise Sources and Power Supplies.



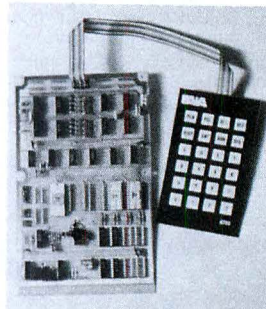
All modules are compatible with the PAIA 8780 Equally Tempered DAC and 8782 Encoded keyboard for easy computer/microprocessor/micro-controller interface.

Available in kit form from PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116. A free catalog is available upon request.

CIRCLE INQUIRY NO. 137

The PAIA 8700 Computer/Controller

The PAIA 8700 Computer/Controller is an applications oriented 6503 based microprocessor system featuring 1K bytes RAM locations (512 bytes supplied), 1K bytes ROM locations with 256 byte monitor included.



The 8700 has two 8 bit input ports and two 8 bit output ports, one latched, one buffered. A 24 key touch operated keypad is used by the monitor to allow entry and execution of user programs and is also user definable. The 8780 includes two seven segment displays which are used by the monitor to display memory location and contents and are also easily user programmed. An optional (\$22.50 additional) cassette interface is also available that fits entirely on the processor board.

The 8780 is the ideal, low cost, solution to implementing computer based control systems. PAIA software currently available or under development includes: A home applications package including: Multi-zone fire and burglar alarm, real time clock, energy saving heat and air conditioning control, computer generated "door-bell"; Electronic music synthesizer interface; Model railroad controller and more.

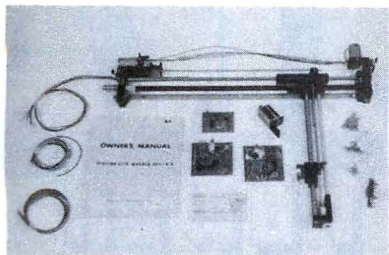
The complete kit for the 8780 Computer/Controller is priced at \$149.95 (plus \$3.00 postage shipped direct from PAIA) and is also available at full line computer stores. PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116.

CIRCLE INQUIRY NO. 138

Low Cost X-Y Plotters

Sylvan Hills Lab announces the availability of 8080 based software to control their series of plotters. This enables the microcomputer to act as the controller for the plotter and requires about 2K of memory. The software format is such that it may be used in conjunction

with application routines available from Micro-Visions, Inc., 4926 Travis, Houston, TX 77002.



Plotters are shipped completely assembled and tested, but require the purchaser to mount them on his drawing surface and do the inter-connection between the control PC boards and his computer. Requires an 8 bit parallel I/O port and 5 and 24 volt power sources.

Applications include architectural, mechanical, and schematic drawing; PC board artwork; positioning of small objects; computer generated art; games; and many others. Sizes available are 11 x 17 (\$750), 17 x 22 (\$895) and 22 x 34 (\$1200). For further information, contact Sylvan Hills Lab, Inc., #1 Sylvanway, Box 239, Strafford, MO 65757, (417) 736-2664.

CIRCLE INQUIRY NO. 139

The Pennywhistle 103

The Pennywhistle 103 Acoustic Coupler is the first professional quality modem available in kit form. The Pennywhistle may be used either as an acoustic coupler (with the telephone handset) or it may be wired directly into the telephone via a DAA. In either case, the modem will operate in both the half-duplex (unidirectional) or full-duplex (bidirectional) modes.



One of the most significant problems associated with modems is that there is often difficulty in determining the difference between a signal of the proper frequency and one of its harmonics. The Pennywhistle 103, however, employs a *three-stage* active filter which prevents noise and harmonics from getting through.

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. It is free of critical adjustments and is built with non-precision, readily available components.

The Pennywhistle kit includes everything needed to build the entire unit. All electronic components mount on a single 5" by 9" printed circuit board. The kit also includes all chassis parts, speakers, speaker grilles, muffs and line cord.

The Pennywhistle 103 modem kit is \$129.95 and is available from M&R Engineers, P.O. Box 61011, Sunnyvale, CA 94088.

CIRCLE INQUIRY NO. 163

Add Hard Copy to Your System New Altair Line Printers

The Altair C700 interfaces with the Altair 8800 series microcomputers and is a high-speed serial character printer which prints up

to 60 characters per second. The printhead is a 5x7 dot matrix which prints the 64 character subset of the ASCII font.



The printer operates in a highly efficient yet unique manner. The C700 calculates the most rapid way to print each line so that unnecessary carriage returns are eliminated.

The C700 provides other superior features for easy operation with minimal maintenance. Each printer is furnished with form tractors to accommodate forms up to 15 inches in width.

When set to print less than 132 centered character lines, the C700 has increased throughput, since the printhead returns to the right or left margin. This special feature results in minimal wear since parts motion is reduced to an absolute minimum. A circuit which allows power to be decreased when the print is inactive further reduces wear.

The C700 printer is easily integrated into any Altair 8800 computer system. Each comes with its own special interface card which is plugged into the Altair bus. Ribbon cables and connectors complete the interface by connecting the printer to the computer via the interface board.

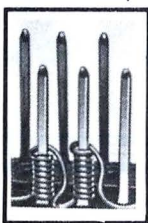
Check with MITS or your local dealer for prices and availability. MITS, Inc., 2450 Alamo S.E., Albuquerque, New Mexico 87106.

CIRCLE INQUIRY NO. 289

Vector announces revolutionary wiring tools

SLIT-WRAP

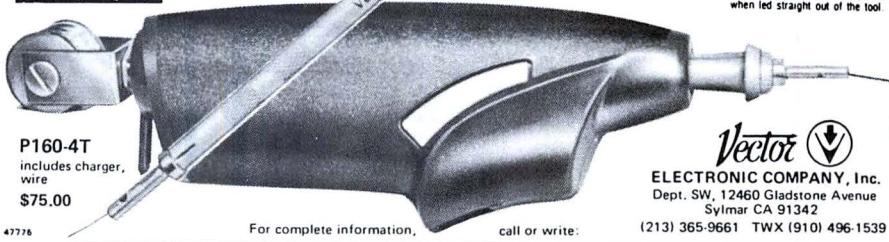
ORDER FROM FACTORY.
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Wraps insulated wire on .025" square posts
FOUR TIMES FASTER
than regular manual wrap-post tools

NO PRE-STRIPPING
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SPOOL-FED
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"Daisy-chain" runs
Reliable and easy to use
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P160-4T
includes charger,
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For complete information,

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ELECTRONIC COMPANY, Inc.
Dept. SW, 12460 Gladstone Avenue
Sylmar CA 91342
(213) 365-9661 TWX (910) 496-1539

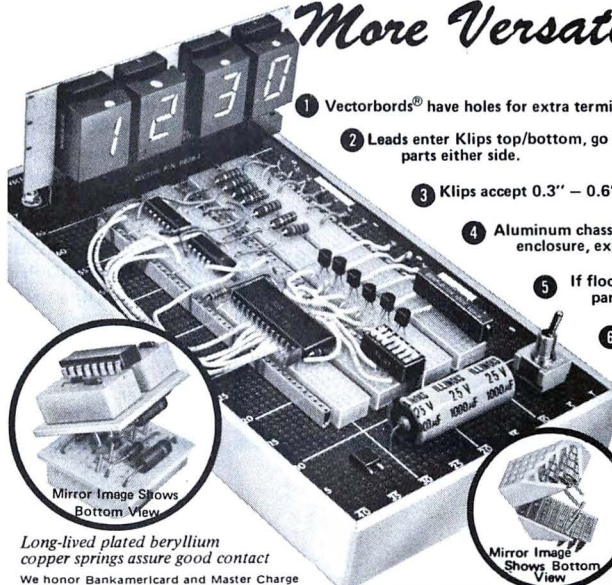
P180
with two 100' spools
of 28 ga. wire
\$24.95

It works the
spooled wire
passes through
the tool past a
slitting edge next
to the wrap post.

A narrow longitudinal
cut is made in the
insulation where it
presses the square
post corner. The bare
copper is indented
by the sharp edge.
(7 turns = 28 con-
tacts)
Insulation is slit where wrapped
but not between terminal posts,
when led straight out of the tool.

VIEW OF UNWRAPPED
WIRE - .025" sq. POST

Vector Klip-Blok Breadboards Are More Versatile because...



1 Vectorboards® have holes for extra terminals and miscellaneous parts.

2 Leads enter Klips/bottom, go through like P.C. boards to mount parts either side.

3 Klips accept 0.3" - 0.6" tab spacing. Reposition as desired.

4 Aluminum chassis holds boards for top/bottom access, enclosure, expandability, and rack mounting.

5 If floor space is tight, bus strips and other parts can mount on bottom to save space.

6 X-Y hole & zone marking provided.

Solderless Push-in Connections

Model 51X (illustrated) holds twelve 14- or 16-pin DIPs, ten 24-pin or four 40-pin devices. \$25.50 assembled. (Circuit elements not incl.)

Model 50X accepts up to six 14- or 16-pin DIPs or one 24-pin plus three 14- or 16-pin DIPs. \$15.00

Model 49X accepts up to three 14- or 16-pin DIPs, or one 24-pin or one 40-pin DIP. \$9.50

Long-lived plated beryllium
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Vector

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CIRCLE INQUIRY NO. 55

ULTRA

THE FORMULA FOR POWER



+ Z-80

= IMSAI Z-80

	<u>Kit</u>	<u>Assembled</u>
IMSAI Z-80 standard (without 8080 CPU)		
with powerful TDL ZPU Board	794.00	994.00
IMSAI Z-80 with 22 slot board	839.00	1039.00
IMSAI 8080 with 6 slot board	594.00	794.00
IMSAI 8080 with 22 slot board	619.00	819.00
for presoldered 22 slot board add \$160.00		
(includes cost of connectors and card guides)		
Connectors (for IMSAI)		4.00
Card Guides, one pair (for IMSAI)		1.00
IMSAI 4A-4 RAM Board	129.00	229.00
IMSAI MIO Board	180.00	300.00
IMSAI Priority Interrupt/Interval		
Clock Board	112.50	212.50
IMSAI 1 Port Parallel I/O Board	85.00	125.00
IMSAI 4 Port Parallel I/O Board	140.00	240.00
IMSAI 1 Channel Serial I/O Board	112.50	192.50
IMSAI 2 Channel Serial I/O Board	140.00	240.00
Socket sets for above — call for pricing		
Cable assemblies for above — call for pricing		
ICOM's Frugal Floppy, with Drive, CF 360		
controller, all cables and connectors	N/A	1129.00
ICOM's Frugal Floppy with Dual Drives ...	N/A	1749.00
Complete Dual Drive system with ICOM Dual		
drives, Power Supply, Controller, Interface/		
Software, in a Synetics Designs box	N/A	2445.00

Prices Subject to Change Without Notice

	<u>Kit</u>	<u>Assembled</u>
ICOM's Microfloppy Disk System, including Drive, Power Supply, Cabinet, Controller/Interface, Software, Manuals and Diskettes	N/A	995.00
TDL System Monitor Board	275	355.00
TDL 4K Expandable Memory (expandable to 16K)	275.00	189.00
TDL 8K Expandable Memory (expandable to 16K)	279.00	339.00
TDL 12K Expandable Memory (expandable to 16K)	392.00	482.00
TDL 4K Expansion Modules	135.00	165.00
TDL 16K Memory Board	549.00	669.00
TDL Z-80 ZPU Board	242.00	300.00
OAE Paper Tape Reader (OP-80A)	73.50	88.50
Seals 8K memory board, 500 ns maximum ..	255.00	300.00
Seals 8K memory board, 225 ns maximum ..	280.00	340.00
SOROC IQ 120 Intelligent Terminal	990.00	1280.00
Lear Siegler ADM-3A Terminal	875.00	1050.00
OKI Data 110 Printer: 110 CPS dot matrix line printer, tractor		
feed with RS232 interface	N/A	1475.00
Merlin Video Board with MBI & MEI	330.00	390.00



NEW PHONE—CALL (714) 731-5197 NOW!

BYTE

THE FORMULA FOR MEMORY



**= COMPLETE MICROPROCESSOR
FLOPPY DISK SYSTEM**

THE FORMULA FOR MEMORY

This fantastic combination is made up of the Vector 1 computer (8080 full vector/interrupt CPU with PROM/RAM board and serial I/O) and the North Star Micro-Disk System. The disk drive, controller, interface and power supply, all fit snugly inside the Vector 1 cabinet, accessible from the front of the machine, giving you a microprocessor/floppy disk system in one cabinet — the Vector-Plus!

Vector-Plus with North Star Micro-Disk System
1351.25(k) 1651.25 (A)

VECTOR 1

This 8080 based computer comes fully equipped with all you need to get started! It houses an 8080 based CPU with vectored priority interrupts and a real time clock. Its PROM/RAM board with 1K RAM and room for 2 1702A PROMS eliminates the need for a front panel with its jump-on-reset feature (enables you to hit reset and go to any location in memory determined by the first command on PROM). The PROM/RAM board also houses three options of SIO: (A) 3P + S, MITS SIO Rev. 1; (B) MITS 2 SIO; (C) IMSAI SIO 2 (please specify which you prefer when ordering). This system is housed in a custom cabinet, 18 slot mother board S-100 Bus with 6 connectors and card guides, and an 18A, 8V; 2.5A \pm 16V power supply.

	Kit	Assembled
Vector 1 Microcomputer (as above)	557.00	777.00
Vector Z-80 (as above but with TDL ZPU)	739.00	959.00
PROM/RAM board with 1K RAM, space for 2 1702A PROMs (state option A, B, or C)	119.00	149.00
512 Byte Monitor on 2 1702A PROMs (9 commands), used with TARBELL mode; specify A, B, or C	40.00	60.00
Additional 12 connectors and card guides		54.00

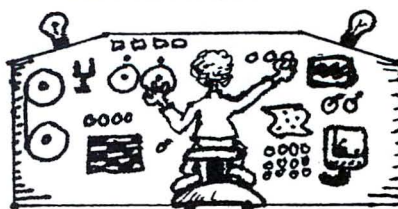
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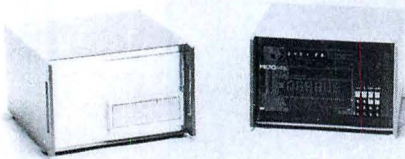


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Discs

Matching Micro-Computer and Floppy Disc System

Both the Floppy Disc and Micro-Computer are mounted in identical, ruggedized medium blue aluminum cabinets.



The Micro-68B computer lists for \$1878.00 and comes complete with 8K words of RAM memory, 1K MIK-BUG monitor system and audio Cassette, TTY, RS232C interfaces. The Micro-68b has a 13-slot EXORCisor compatible motherboard and a 20 amp 5 volt power supply (± 12 volts at 1 amp also included). Power connections are provided for 115/230 volts 50/60 hz. Input/Output can be handled via either the built-in hexadecimal keyboard and LED display or via 20 ma. or a RS232C serial interface.

The IBM compatible Micro-68 Floppy Disc System is available in either single or dual configurations and comes complete with power supplies, interface to the Micro-68 computer controller and disc drive electronics. Each disc holds $\frac{1}{4}$ million bytes of information and is EX-ORCisor compatible.

The Micro-68b lists for \$1878.00; the Single Floppy Disc System for \$2595; and the Dual Floppy System for \$3295. Software available includes Fortran IV, basic, Assembler, Editor and Floppy Disc Operating System. Delivery is one week. U.S. prices quoted.

For further information please contact: Patti Neumann, Director of Marketing, Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110, (714) 276-8911.

CIRCLE INQUIRY NO. 141

FD-8 Floppy Disc Memory System

The MSI FD-8 Floppy Disc Memory System interfaces to any microcomputer system via a single PIA chip. The FD-8 uses GSI disc drives with each drive housed in its own cabinet complete with power supply. The disc controller board is contained in the same cabinet as the No. 1 drive and communicates to the microcomputer system by means of a small ribbon cable. Up to four disc drives connect to the No. 1 drive by means of a parallel cable. Each additional drive is contained in its own matching cabinet with power supply.



The interface to the microcomputer system is by means of a single PIA chip. One half of the chip is utilized as an eight bit bi-directional port for data flow and status information. The

second half of the PIA is used as an output control port. The MSI PIA-1 parallel interface card is all that is needed for SWTP 6800 systems. An 88-4PIO or 3P + S interface card will handle the interfacing job for Altair and IMSAI 8080 systems.

The MSI FDOS Floppy Disc Operating System is available for 6800 based systems. For 8080 based systems, our disc driver routines and MINI-DOS may be integrated with BASIC via user-defined subroutines.

For further information contact Midwest Scientific Instruments, Inc., 220 West Cedar, Olathe, Kansas 66061, (913) 764-3273.

CIRCLE INQUIRY NO. 142

System 80-2 Dual Minifloppy

To accompany the MERLIN ASCII graphics video interface, the first dual mini-floppy s100 mainframed SYSTEM 80-2 is now on the market equipped with a rugged card rack, 8-slots goldplated edge connectors and heavy duty power supply.

The power supply provides 10A @ 8V, 3A @ $\pm 16V$ and regulated +5V and +12V for two minifloppy drives.

The unit comes completely assembled and tested and is available with or without drive.

The introductory single price (without drive) is \$499.00. The CPU, floppy interface, MERLIN video interface and other cards are available separately.

For further information contact Mini-Term Associates, Box 268, Bedford, MA 01730 or call (617) 648-1200.

CIRCLE INQUIRY NO. 143

Model 200 MINIDRIVE™

The Qantex MINIDRIVE™ is super compact, 3 inches high by 4 inches deep by 4.125 inches wide and weighs only one pound. It features design simplicity including an aluminum base place for mechanical integrity with automatic and positive cartridge positioning. The servo loop includes a solid state optical tachometer for precise speed control of the low inertia DC motor. The Model 200 includes a completely solid state Tape Mark Sensor for detection of beginning of tape and end of tape.

The Model 200 MINIDRIVE™ is available with 800 bpi or optional 1600 bpi density resulting in a transfer rate of 24,000 or 48,000 bits per second at 30 inches per second. The storage capacity is from 168,000 bytes for a MINIDRIVE™ with a single track head and 800 bpi packing density to 772,000 bytes of unformatted data for a MINIDRIVE™ with a dual track head and 1600 bpi tracking density.

The versatility allows Qantex to supply the Model 200 MINIDRIVE™ with a direct interface to the Motorola 6800 and Intel 8080 microprocessors. The MINIDRIVE™ is upward compatible with its predecessor the Model 600/650 and Formatters, thus making it available with interfaces to the PDP-11, LSI-11, Data General, Rolm, Interdata and Altair computers.

For further information, contact Qantex, Division of North Atlantic Industries, 200 Terminal Dr., Plainview, NY 11803, (516) 681-8350.

CIRCLE INQUIRY NO. 144

New Altair Minidisk Stores over 71K

The miniaturization of mass storage is just one of the exciting features of the new Altair Minidisk System. Designed to work with the Altair microcomputers, the Minidisk has a storage capacity of over 71K bytes per diskette with an access time of less than three seconds.



Altair Minidisk BASIC resides in the lower 20K of Altair 8800b memory (lower 12K in the Altair 680b) and provides the disk utilization routines. Minidisk BASIC includes the standard functions of 8K BASIC, plus many extra file maintenance procedures that significantly increase programming power. The software driver for the Minidisk Read/Write functions is based on the hard sectoring format, which simplifies system configuration.

The Altair 8800b computer interacts with the Minidisk Drive through two Minidisk Controller Cards that plug into the Altair bus. The Altair 680b uses a single board controller. All control, status and data I/O signals are handled through I/O ports dedicated to the Minidisk Controller. To insure maximum life of the drive motor, a timer in the Controller turns the system off if the Minidisk is not accessed for five seconds.

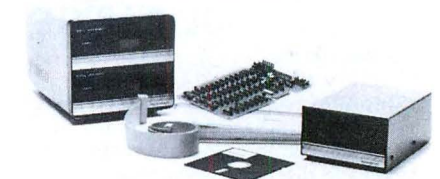
The Minidisk Drive Case contains a disc drive, power supply, line buffers and addressing circuitry. The drive address is switch selectable. The selected address is displayed on the front panel for easy identification. Write protect is also a standard feature on the drive.

For further information, contact MITS, Inc., 2450 Alamo S.E., Albuquerque, N.M. 87106.

CIRCLE INQUIRY NO. 145

New Floppy Family Packs Large System Performance in 5 1/4-inch Format

A family of fully integrated floppy disc systems from Micropolis Corporation is the first to package the performance and storage capacity of 8-inch discs in a 5 1/4-inch format, at the same price as comparably sized units.



Designed to make the 5 1/4-inch format viable in cost and performance for OEM's and home computer hobbyists alike, the MetaFloppy family of four systems offers the additional advantages of plug-in microprocessor compatibility and a complete BASIC software package.

They are available in single and dual drives with capacities ranging from 143 to 630 kilobytes. All four MetaFloppy systems also promise to reduce error rates by a factor of 10 — compared to other like-size drives — and increase system longevity via proprietary electro-mechanical design techniques.

Two compact dual units round out the fami-

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NEW

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ADM-3A TERMINAL**



- Full addressable cursor.
- Display Format— Standard: 1920 characters, displayed in 24 lines of 80 characters per line.
- Communications Rates— 75 to 19,200 baud (switch selectable).
- Computer Interfaces— EIA standard RS232C and 20mA current-loop (switch selectable).

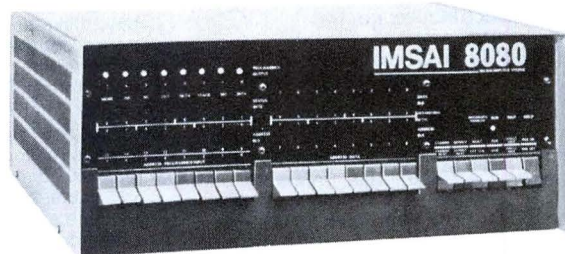
ADM-3A Kit \$839.95

ADM-3A Assembled . . . \$1079.95

Lower Case Option . . . \$89.00

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IMSAI 8080 MICROCOMPUTER



Powerful • Easy to use • Low cost

With 22 Slot Mother Board . . . \$619.95

With Z-80 CPU \$849.95

OKIDATA Model 110 Line Printer



- 110 CPS
dot matrix

Friction Feed \$1099.00

Tractor Feed \$1229.00

RS 232C Serial Interface . . . \$250.00



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ly. The Model 1053-Mod I stores 286 kilobytes at a price of \$1545 while the Model 1053-Mod II packs 630K bytes and a \$1795 price tag. Both include power supply, controller, cable, extended disc BASIC and power supply. All prices shown are quantity one.

The basic system is particularly designed to accommodate users who want the convenience and low price of 5 1/4-inch discs but find the 70K byte capacity of conventional models too small for practical usage.

The proprietary MetaFloppy controller/interface option is particularly beneficial to computer hobbyists, who can now plug directly into their MITS 8800, IMSAI 8080, COMPAL, or Polymorphic 88 microcomputers.

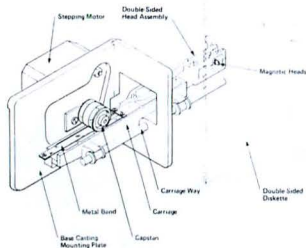
The controller accommodates up to four single drives or two duals, or any mix. This enables users to start with a single unit and continue to add others as their needs increase, with no additional controller costs.

All MetaFloppy systems are available 30 days ARO. For further information contact Micropolis Corporation, 9017 Reseda Blvd., Northridge, CA 91324.

CIRCLE INQUIRY NO. 146

SA850/851 Double-Sided Floppy Disc Drive

The new SA850/851 double-sided floppy stores up to four times the data of a standard floppy drive — or 1600 kbytes unformatted and 1200 kbytes formatted. The SA850/851 is available with single density (FM encoding) and double density (M²FM) capability as standard features. The new unit is exactly the same physical size as Shugart's standard SA800 floppy (4.62" high x 9.50" wide x 14.25" deep); in addition, a skinny version SA850/851R is available to allow side-by-side mounting in a nineteen inch RETMA rack (4.62" high x 8.55" wide x 14.25" deep).



The SA850/851 is plug compatible with the Shugart SA800/801 standard drive and is media interchangeable with the IBM 3740, S/32 single sided floppy drives, as well as the recently announced IBM Series/1 (Model 4964) and 3600 series two-sided drives which utilize double-sided IBM diskette 2 media or its equivalent. The SA850/851 drives read and write data on any industry standard diskette as well as the IBM two-sided Diskette 2 or similar diskettes provided by other media manufacturers. A dual index sensor is used to differentiate between single and two-sided diskettes.

The SA850/851 drive offers improved access time of 3 ms track-to-track, utilizing Shugart's proprietary FasflexTM actuator (patent applied for). Developed exclusively for the SA850/851, this unique actuator utilizes a flexible metal band for low friction head movement with high accuracy and reliability.

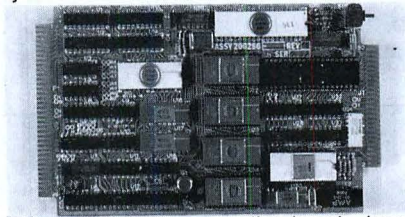
For more information, contact Shugart Associates, W. Ferrell Sanders, Vice President, Marketing, 415 Oakmead Parkway, Sunnyvale, CA 94086, (408) 733-0100 or Lutat, Battey & Associates, (408) 246-6594.

CIRCLE INQUIRY NO. 147

Intelligent Floppy Diskette Multidrive

The PerSci series 1070 is the first truly intelligent diskette controller with its own 8080

microcomputer and file type disc operating system capable of being interfaced to any microcomputer. The 1070 series controller provides on board capabilities to communicate by file name with most microcomputers and, at the same time, takes care of all housekeeping functions. One controller board controls up to four PerSci model 70 single diskette drives or up to two PerSci model 277 dual diskette drives, providing a high-performance mass storage subsystem with an on-line data storage capacity of more than one million bytes.



The 1070 series controller boards incorporate an 8080 CPU and its associated support IC's, a Western Digital #FD1771 single-chip floppy, diskette drive controller, 4K bytes of ROM (or optional EPROM), DOS file management firmware, 1K bytes of RAM input/output buffer storage, an eight-bit parallel microcomputer interface, and an optional RS232 serial asynchronous interface.

The disc recording format is IBM soft sector 3740 compatible with each disc containing 77 tracts, 26 sectors per track, and 128 data bytes per sector. The first track is reserved by the disc controller as a file index track, while the remaining 76 tracks are available for data storage. Maximum formatted disc capacity is 252,928 bytes, excluding the index track.

Series 1070 controller PCB size is 4.5" x 7" and requires +5V and ±12 volt power.

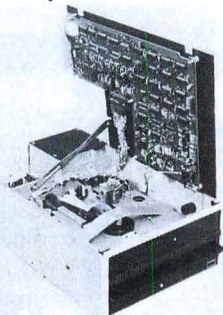
Price, single quantity price of the completely assembled and tested 1070 controller board is \$640.00 plus options. OEM quantity discounts are available.

For additional information contact Herbert G. Waite, Director of Marketing, PerSci, 12210 Nebraska Ave., W. Los Angeles, CA 90025, or call (213) 820-3764.

CIRCLE INQUIRY NO. 148

Series 400 Floppy Disc

Offering an array of new features that were previously unavailable in the market, the Series 400 marks an important advance in the state of the art in floppy disc technology. Unique new features include automatic head-unload and stepper motor time-outs, bi-directional write-protect, radial stepping ability for truly overlapping seeks, host power failure detector, 6 different L.E.D. activity indicators, and 50-PIN ribbon cable or twisted pair interfacing compatibility.



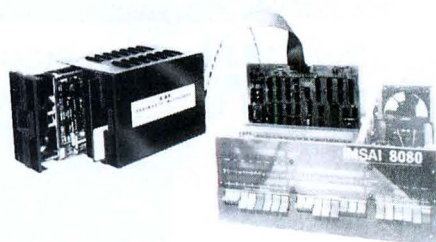
Both the Model 410 (soft-sectored, IBM-compatible) and the Model 420 (hard-sectored) provide single and double density recording capability while incorporating electrical features previously unavailable on any other floppy disc. In addition, a proprietary data separator design, coupled with a digital noise filter and a unique way of handling recorded signals, results in 35 percent greater data integrity margins than available from the closest competitor.

Prices for the Innovex Series 400 range from \$575 in single quantities to \$435 each for orders of 100. Deliveries began in March and are quoted at 30 days ARO. Innovex Corporation, 75 Wiggins Ave., Bedford, Mass. 02142.

CIRCLE INQUIRY NO. 149

Fortran IV — MinifloppyTM Kit for Hobbyist Market

The kit includes a Shugart SA400 minifloppyTM disc drive, cables and cabinet; an interface module kit; a disc operating system with file management; a text editor; and FORT/80, FORTRAN IC for the 8080 microcomputer (distributed in the U.S. under license from Unified Technologies of Canada). The kit will operate with any standard S-100 bus system with 20K of RAM.



The interface module is an S-100 bus plugable, fully socketed PC board with an on-board bootstrap and diagnostic PROM. The interface can control two minifloppy drives. Power is supplied from the S-100 bus, with power regulators on the board for the first drive. Power regulation hardware is supplied with the second drive, when ordered.

The interface module is a disc driver and parallel I/O module in one. It features an on-board crystal controlled timer, providing compatibility with any 8080 series processor, independent of cycle time.

Also included are vectored interrupts, selectable to any of 7 possible vectors with software sensing of interrupt and enable/disable status. The module also includes an 8 bit parallel input port with input strobe and an 8 bit parallel latching output port with output strobe.

Complete documentation, a 90 day warranty, factory support, and a two year software and documentation update service are provided.

The FORTAN IV-Minifloppy kit is priced at \$1095. A completely assembled and tested unit is \$1220. A second minifloppy drive, regulator, and cable kit sells for \$449 (\$495 assembled and tested). Additional formatted diskettes are \$5. Deliveries are from stock, beginning June 1. For further information, contact Realistic Controls Corporation, 3530 Warransville Center Rd., Cleveland, OH 44122, (216) 751-3158.

*Minifloppy and minidiskette are trademarks of Shugart Associates.

CIRCLE INQUIRY NO. 150

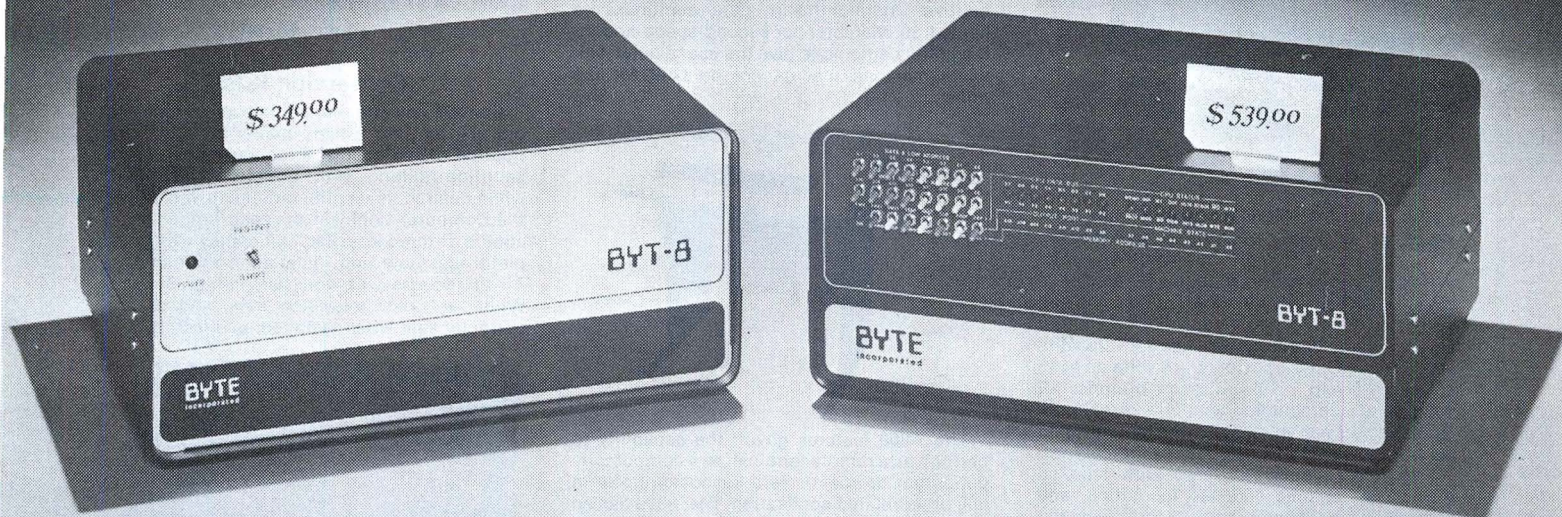
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The Byt-8. It doesn't have a nifty (and expensive) front panel with lots of LED's and toggle switches.

And we obviously don't have a big full-color ad.

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For \$349, you get the complete microcomputer card, motherboard, power supply and chassis in kit form.

The Byt-8 S100 bus is the same one used by Altair, IMSAI and most others so you have the greatest possible flexibility in choosing memory and input/output cards.

Optional cards from the Byte Shop in-

clude 4k, 8k or 16k of Random Access Memory, 4k or 8k of Programmable Read-Only Memory, a multiple input/output card, a TV typewriter card and, yes, a front panel bootstrap card, if you want the LED's and switches.

Even the CPU is optional. We'll sell you the chassis, motherboard and power supply for \$229, and you can choose your own microcomputer card — a ZPU for instance?

Byt-8. It's the new low in price, but we're aiming for a new high in flexibility, delivery and support. See the Byt-8 at your nearest Byte Shop.

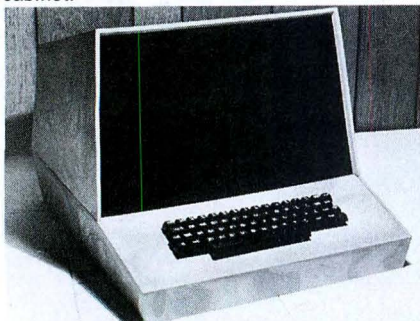
BYTE SHOP
the affordable computer store

Stores now open in Arizona, Phoenix, Tempe, Tucson; **California**, Berkeley, Burbank, Campbell, Diablo Valley, Fresno, Hayward, Lawndale, Long Beach, Mountain View, Palo Alto, Pasadena, Placentia, Sacramento, San Diego, San Fernando Valley, San Francisco, Santa Barbara, Stockton, Tarzana, Thousand Oaks, Ventura, Westminster; **Colorado**, Arapahoe County, Boulder, Englewood; **Florida**, Cocoa Beach, Fort Lauderdale, Miami; **Indiana**, Indianapolis; **Minnesota**, Eagan, Minneapolis/St. Paul; **New York**, Levittown, Rochester; **Ohio**, Columbus, Rocky River; **Oregon**, Beaverton, Portland; **Pennsylvania**, Bryn Mawr; **South Carolina**, Columbia; **Utah**, Salt Lake City; **Washington**, Bellevue; **Canada**, Vancouver, Winnipeg; **Japan**, Tokyo. If there's no Byte Shop near you yet, please write or call Byte Inc., 1261 Birchwood Drive, Sunnyvale, California 94086 • (408) 734-9000 for more information on our Byt-8 system.

Terminals

The Versatile CRT — Much More Than A Display Monitor

Assembled and tested at the factory, The Versatile CRT consists of a commercial 9" video monitor, ASR 33-type ASCII keyboard, and fully powered mainframe. All components are enclosed in a unified rugged, lightweight cabinet.



The mainframe includes a card rack with space for ten S-100 bus cards, a mother board with room for ten 10-pin ALTAIR/IMSAI compatible edge connectors with power rated at 20 amps dc, a Blazer 75 cfm Whisper Fan, and sufficient power to support your microcomputer and peripheral. Input power uses 110-125 volts ac, 60 cycle. Output power is +8 volts dc at 15 amps, +18 and -18 volt dc at 8 amps. All voltages are unregulated with one 20,000 mfd. GE capacitor per voltage. Power is controlled via an on/off switch at the rear of the cabinet.

The video display, covered with smoked plexiglass, features 500 line resolution, and controls for horizontal, vertical, contrast and brightness. The cabinet is made of high quality NORYL™ plastic with ventilation slots in the base and is ideally suited to modifications for expansion.

The Versatile CRT includes all necessary power supplies, plugs and connectors. Add your own CPU, video board, memory and peripheral, then plug it in and you're up and running. The manufacturer provides a 90 day warranty on all parts to the original purchaser from date of delivery. Moderately priced at \$699.95, The Versatile CRT is available within 20 days of order, through dealers nationwide.

For more information contact Robert Boyer, Computer Data Systems, English Village, Atrium #3, Newark, DE 19711, or phone (302) 738-7697.

CIRCLE INQUIRY NO. 151

The Heart of the Dataproducts Printer—The Hammer—Now Available to Other Manufacturers

Dataproducts Corporation's highly respected Mark IV print hammer is being made available to other computer manufacturers as well as any OEM (original equipment manufacturer) that wants to build a printer into some other kind of equipment. This is believed to be the first time that a printer manufacturer has offered to sell the most proprietary part of its most successful product line to any other company.

Typical applications for the Mark IV hammer include label and ticket printers, column and line printers, and any other application requiring full-character printing.

Impact of the Mark IV is actuated by a current that flows through a flat voice coil mechanism. The hammer tip is mounted on top of the coil and this assembly is suspended by two flex-pivot springs. The springs also serve as the current path to the coil. The coil is

placed between permanent magnets, and a current in the coil produces a force that causes the hammer to impact the paper, ribbon, and character.

Basic hammer in 1000 quantities is \$14.95. Standard hammers from stock. For further information, contact Dataproducts Corporation, 6219 De Soto Avenue, Woodland Hills, CA 91364, (213) 887-8000.

CIRCLE INQUIRY NO. 152

Alanthus Model T-300 Data Terminal

The Alanthus Model T-300 is a cost competitive, state-of-the-art data terminal. Its honest 30 character-per-second speed and its flexibility combine to give the user a quiet, versatile machine that cannot be beat for the price.



The T-300 features give it the capability to perform as a remote terminal, as a computer input/output device, or as a keyboard-printer in any other related application. The T-300 has an ANSI-standard, typewriter-style keyboard for the 128 character, ASCII character set. The unit prints ten characters per inch and 132 characters per line.

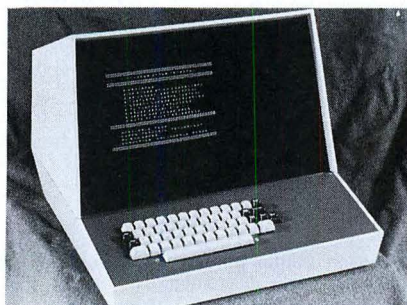
Operation of the T-300 may be selected as on-line or off-line. The standard on-line interface is the 20 ma current loop (EIA is optional), and baud rates of 110, 150 and 200 may be selected. A sixteen character buffer plus a 60 cps "catch-up" mode assure the user true 30 cps throughout.

For further information contact Alanthus Data Communications, 2210 Gladwick St., Compton, CA 90220.

CIRCLE INQUIRY NO. 153

VT-4800 Video Computer Terminal Affords 48 Lines of 80 Characters

The VT-4800 Video Computer Terminal, from Video Terminal Technology, is the only stand-alone video terminal on the market today to offer the features of a professional terminal at a hobbyist price.



The VT-4800 displays 48 lines of 80 characters in a 5x7 matrix. Other features include upper and lower case (custom character sets optional), direct cursor addressing, up and down scrolling, selective clearing controls, selective

video inversion, and all 32 control functions decoded and available for user strapping.

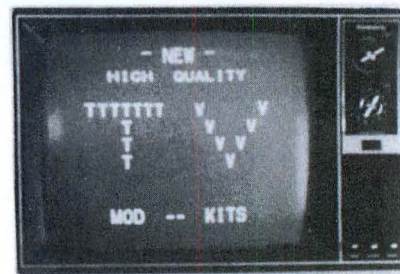
The VT-4800 is easy to interface to any computer with its standard RS232C I/O and selectable baud rate from 110 to 9600. With its direct cursor addressing capability and your software, the VT-4800 can perform sophisticated text editing tasks (character/line correction, insertion, or deletion). An add-on graphic package of 256 by 256 dots will be available later this year. Prices start at \$495.00 for the assembled and tested board and run up to \$1295.00 for the complete assembled model.

Contact VTT Inc., P.O. Box 60485, Sunnyvale, CA 94088, (408) 255-3001.

CIRCLE INQUIRY NO. 154

Conversion Kits

Convert any commercial television receiver, old or new, into a high quality monitor for a fraction of the cost of a regular monitor. You sacrifice nothing, and normal T.V. reception, when desired, is unaffected. Vamp, Inc. offers the computer hobbyist or video enthusiast a choice of three kits. Each kit comes with complete assembly and installation instructions. All of the kits will work with either Black & White or Color television sets, and all are perfectly safe when installed as directed.



TRVM (\$20.95) — This kit is specifically designed for transformer isolated sets only. A buffered non-inverted video signal (some transformer sets require inverted video, therefore, you should use HCVM) is fed to your set's video Amp, thus bypassing the Tuner and I.F. Sections. Very high resolution is possible in this manner.

HCVM (\$24.95) — This is a universal kit. It will work on any set (especially "Hot Chassis" types). It provides both inverted and non-inverted video, and a good isolation between your video source and your T.V. set's power supply.

RFVM (\$9.95) — This is a video only modulator which is operated on a +5 Vdc @ 1 mA and over a frequency range which allows you to choose Channels 2 through 6. The R.F. output of the modulator connects to your set's antenna terminals.

All prices include domestic shipping and handling. Foreign orders should add \$2.00. Write: Vamp, Inc., P.O. Box 29315, Los Angeles, CA 90029.

CIRCLE INQUIRY NO. 155

\$325 Terminal Kit for 8-Bit Computers Offers 16 64-Character Lines, Scrolling, Full Cursor Control, and 110-1200 Baud Interface

The CT-64 features a full 128-character ASCII display with switchable upper or upper and lower case characters, and two 1K memory pages. The terminal is usable with any 8-bit computer.



A \$175 optional fully assembled 9-inch 12 MHz CT-VM monitor with matching cover completes a full CRT terminal.

The CT-64 terminal offers scrolling or page mode operation, 32 control character decoding, selectable control character printing, and character or word highlighting (with reversed background).

The terminal provides full cursor control, home-up and erase, erase to end of line or end of frame, cursor on/off, screen reversal, scroll or page, solid or blinking cursor, page selection, and end-of-page warning beeper.

The kit is complete with keyboard, power supply, 110-1200 baud interface, and case. Further information is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216.

CIRCLE INQUIRY NO. 156

Hardcopy Computer Terminal Cost \$225 with ASCII Keyboard

Abacus Computer Systems has a low cost, portable computer terminal that is suitable for microcomputers, computer evaluation kits, data entry systems and time sharing systems. This terminal weighs under 25 pounds with the integral keyboard, hardcopy printer and acoustical coupler.



The terminal is TTY compatible or it can be connected directly to the computer serial I/O port which has standard TTL voltages level. The acoustical coupler can be used to transmit and receive data over the phone lines. The coupler can also be used to load and store data on audio cassette tapes at speeds up to 300 bauds. The keyboard is ASCII encoded and consists of 51 alphanumeric solid state keys. The printer uses half inch strip, impact sensitive paper. The printer speed is 110 bauds.

The model 800 is \$295 with the coupler and \$225 without the acoustical coupler. For a limited time — 100 rolls of paper included free with purchase of either model. For further information contact Abacus Computer Systems, 6315 Eunice Ave., Los Angeles, CA 90042, (213) 666-1711.

CIRCLE INQUIRY NO. 157

Model 33 Teletypes and Associated Interface Equipment

The model 33 is a low-cost, standard duty line of data terminals that use an eight-level code (ASCII) for data teletypewriter paper (friction feed) or accommodate multiple-copy business forms (sprocket feed). They operate at speeds up to 10 characters per second (110 baud), feature four-row keyboards, and offer a

choice of various character sets. Transmission mode may be half or full duplex. Interface may be DC current which is convertible to E.I.A. RS-232-C by a modification kit or a modem with facilities for manual originate and either manual- or automatic-answer. Terminals are available for operation on either 60 Hz power frequencies. Options include even parity code generation and an answer back for station identification.

Available configurations include:

- Receive-Only (RO) Terminal - Receive data as printed page copy.
- Keyboard Send-Receive (KSR) Terminal - Provides Keyboard data entry and printed page copy.
- Automatic Send-Receive (ASR) Terminal - Provides Keyboard data entry, printed page copy and paper tape punch and reader.

Delivery is available immediately. For further information contact B&M Communications, RD4, Box 272, Hwy #9m Howell, NJ 07731, (201) 780-1880.

CIRCLE INQUIRY NO. 158

The ACT-II - Affordable Computer Terminal #2

The ACT-II allows dial-up phone communications between a home computerist and a remote time sharing system or another home computer as well as dial-up phone communica-



All You Need To Know

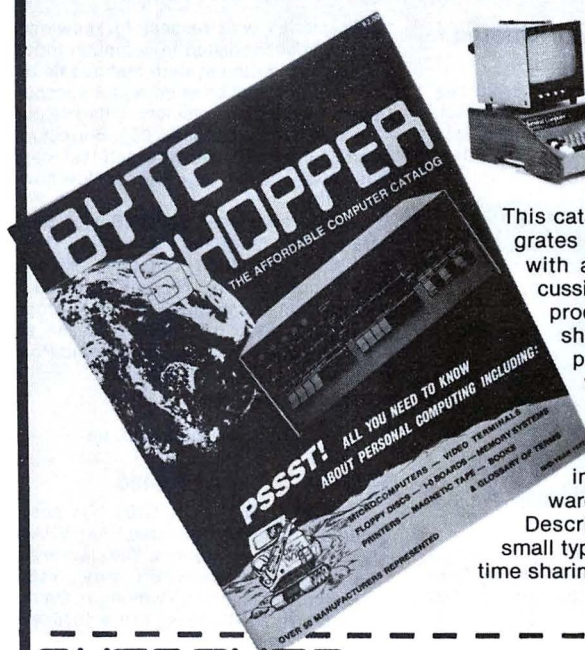
Announcing the BYTE SHOPPER, a unique new catalog design to present the fascinating world of personal computing to anyone.

- Complete description of microcomputer systems
- 50 word glossary of terms
- Introductory text of personal computing
- Over 50 manufacturers represented
- BYTE SHOP price list.
- Large 11" x 14" 40 page format
- Fully illustrated and comprehensive



This catalog, only \$2.00, integrates manufacturers specs with a down to earth discussion of how to use each product and its relationship to an overall computing system. It provides for the first time an effective reference to the broad range of personal computing hardware & software.

Descriptions range from small type home units to large time sharing multi-user systems.



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☐ Visa Card ☐ Mastercharge

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CIRCLE INQUIRY NO. 62

tions between computers.

With a stand-alone ACT-II, remote job entry and execution is economically feasible. The ACT-II (without monitor) slips easily into a briefcase to commute between home and the office. The ACT-II equipped with its optional answer modem makes it possible to communicate with a friend's computer, across town or even across the country and swap software without trading cassettes, paper tapes, or diskettes.

The modem and terminal can operate independently. The modem's TTL in and out lines are available on the rear connectors along with the serial I/O lines of the terminal. When not operating in tandem with the switch selectable full/half duplex 300 baud modem, the ACT-II possesses all of the attractive features of its predecessor - the ACT-I. These features include: a 1024 character display organized as 16 lines of 64 characters; switch selectable UART format and switch selectable data rates from 110 to 19,200 baud; auto scrolling and optional cursor control and bell (beeper). Self testing (loop-back) of both the modem and the terminal is featured.

The ACT-II is fully assembled, warranted for 90 days and costs only \$550. Contact, Micro-Term Inc., P.O. Box 9387, St. Louis, MO 63117, (314) 645-3856.

CIRCLE INQUIRY NO. 159

The ACT-III - Affordable Computer Terminal #3

The ACT-III is a microprocessor based, up-

per and descending lower case, "smart" computer terminal which features three switch selectable display formats: the standard 24 lines of 80 characters plus 48 lines of 39 characters or 72 lines of 26 characters for situations that require simultaneous display of numerous short lines. Auto scrolling is performed in all three modes of data rates up to, and including 19200 baud. The display also features computer controlled video invert, blink and protected data fields. Besides the standard relative cursor control codes, the ACT-III also responds to absolute cursor addressing, erase to end of line, erase to end of frame, and will even report the row and column cursor position to the computer if commanded.



The ACT-III keyboard supports the full ASCII character set (upper and lower case) and several special function keys. Auto repeat is enabled by the cursor control keys, forward and backward space keys and the . key. There are three switch selectable transmission modes: character, line and screen at a time. When in either the line or screen at a time modes, the ACT-III's text editor can be called upon to modify, insert and delete characters or lines of the displayed text before transmission to the CPU. When sending forms or menus to the terminal, the CPU can lockout the ACT-III keyboard to prevent accidental interference from the operator. As many as sixteen tabs may be set across the 80 character line.

Convenience features include: an audible tone emitted to indicate proximity to the end of line; this tone is accompanied by an error message written on the screen to signal an operator error. An RS232C printer port is provided and can operate at data rates from 110 to 9600 baud independent of the I/O data rate between the terminal and the CPU. Data rates are both switch selectable. A switched AC outlet located on the rear of the ACT-III cabinet can provide power to the CRT.

The ACT-III is fully assembled, carries a 90 day warranty and sells for only \$700 in single quantities. For further information contact, Micro-Term Inc., P.O. Box 9387, St. Louis, MO 63117, (314) 645-3656.

CIRCLE INQUIRY NO. 160

I/O Card

Vocal Input to Computer Offered for \$249

A new system compatible with all S-100 bus computers to provide voice input and control, replacing keyboards in many instances, has been announced by Heuristics, Los Altos, California speech research firm.



Known as SpeechLab*, the system is available in selected computer stores and directly from the manufacturer for \$249 in kit form or \$299 assembled and tested.

SpeechLab* digitizes and extracts data from a speech wave form and applies pattern matching techniques to recognize the vocal input. Uses include computer input, games, research and vocal control.

In addition to S-100 bus computers such as Sol, Altair, and Imsai, SpeechLab* can be used with any computer with the aid of a separate power supply and connector.

Included in the price is a complete hardware/software system, a 275 page laboratory manual, 95 page hardware manual, high fidelity microphone, and three programs on paper tape. The lab manual is the only introductory volume on speech recognition currently available, according to the manufacturer.

The lab manual includes 35 graded experiments with over 100 tables and graphs. According to the manufacturer, the system can put the user in a position second only to Bell

Laboratories with respect to knowledge and use of speech related to computer input.

Technically the system features 64 bytes of storage per spoken word and a vocabulary of up to 64 words in memory. Other features include real time response, 95% correct recognition, automatic hardware self-test capability and advanced C-MOS design for low power and reliability.

Software includes SpeechBasic* Basic programming language, assembly language speech recognition program, SpeechBasic plot, correlation, recognition, advanced recognition and hardware self-test programs.

For complete information, please address Heuristics, Inc., 900 N. San Antonio Road, Los Altos, CA 94022, (415) 948-2542.

*T.M. of Heuristics, Inc.

CIRCLE INQUIRY NO. 161

ALT-2480

The ALT-2480 is an S100 bus compatible member of the Matrox video RAM (VRAM) family of TV CRT controllers. The device provides an interface between any S100 bus microprocessor and a TV monitor. On the input side the ALT-2480 looks like a 4096 X 8 static RAM with an access time of 500 μ s. The output is a video signal providing a display of 24 lines by 80 upper and lower case characters. A jumper option on the card allows operation with two pages of 40 characters per line. The 40 character per line option allows use of a low bandwidth monitor. Any character may be displayed as normal, reverse, video or blinking. Other options include American (60Hz) or European (50Hz) standard field rates.

This large variety of options and features allows the ALT-2480 to be adapted to almost any application where the industry standard 24 line by 80 character display format is required. The 24 X 80 format provides twice the number of characters as the 16 X 64 S100 interface made by other manufacturers. This is invaluable for applications such as intelligent terminals and word processors.

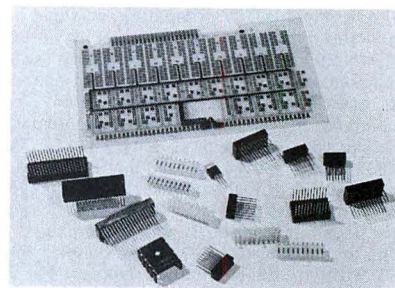
The ALT-2480 is priced at \$295 FOB Mon-

tréal. For further information contact Matrox Electronic Systems, P.O. Box 56, Ahuntsic Stn. Montreal, Que. H3L 3N5, (514) 481-6838.

CIRCLE INQUIRY NO. 162

6800 Wire Wrap Card For SWTP 6800 Computer Systems

The MSI Wire Wrap Card is designed to plug into the SWTP 6800 Computer Bus. The card is 9" wide by 5 1/2" high and contains a 44 pin connector on the top edge of the card for connections to external devices. Molex connectors attach to the bottom edge to allow the card to be plugged into the main 50 pin bus of the 6800 system.



Busing is provided for +5V and ground as well as a position for a 7805 five volt regulator with heat sink. Additional pads are provided for the installation of discrete components. The kit is furnished with the Molex bus connectors included.

Wire Wrap Card, Model WW-1 costs \$25.00 Kit; Wire Wrap Card with 5V regulator and heat sink, Model WW-1R costs \$35.00 Kit; Wire Wrap Sockets: 14 pin, each \$.75; 16 pin, each \$.80; 24 pin, each \$1.50; 40 pin, each \$2.50.

For further information contact Midwest Scientific Instruments, 220 W. Cedar, Olathe, KS 66061; (913) 764-3292.

CIRCLE INQUIRY NO. 292

M712 Bi-Directional I/O Port

The M712 from MicroLogic is an 8-bit parallel I/O port consisting of a bidirectional data bus and four hardware-generated strobe signals (2 input, 2 output). It is a single Altair bus compatible card and will operate with all Altair/Imesai/Sol/PolyMorphic CPUs.

The M712 is the simplest and most economical way to interface the DG cassette system since it was designed specifically for that purpose.

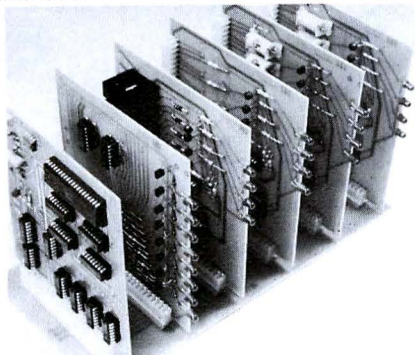
Price is \$69.95 kit, \$79.95 assembled and tested. All MicroLogic PC boards are top-quality, plated-thru, gold-plated contacts, and all ICs are socketed.

For further information contact MicroLogic, P.O. Box 55484, Indianapolis, IN 46220, (317) 259-4289.

CIRCLE INQUIRY NO. 293

XPRES Interface

A complete line of interface circuits has been announced by CRC Engineering, Inc. The interface system called XPRES will allow control of up to 128 separate devices or circuits through one eight bit port or one ASCII serial interface.



Devices controlled may include a home or business energy management system, stereo system, room lights, sprinkler systems, burglar systems, or experiments in a university environment. XPRES consists of a mother board and appropriate interface boards depending on the interface application.

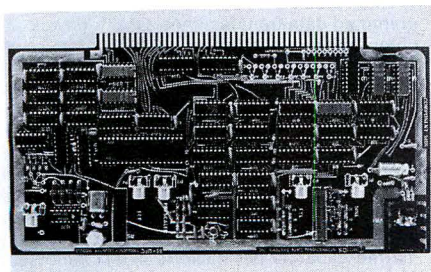
LED's display the status of each interface board and of the eight bit XPRES bus. A system enclosure is available for XPRES which allows all status LED's to show through the red plexiglass front panel.

Other interface circuits will be added as the system develops. Complete information may be obtained from CRC Engineering, Inc., P.O. Box 6263, Bellevue, WA 98007.

CIRCLE INQUIRY NO. 164

Frequency/Period Measurement Module for Altair/IMSAI/S-100 Bus Computers

Precise frequency and period measurement are possible using the 88-UFC 9-decade Universal Frequency Counter Module. All features and functions are software selected and controlled, giving the 88-UFC capabilities which were previously only available on counters costing several times its price.



The Counter includes provisions for four

signal sources. The signal to be measured is selected under software control. Three of the inputs are general purpose and accept analog or digital signals. The fourth input accepts TTL level signals and is extremely useful when using the 88-UFC as an integral part of a hardware system or as a testing tool. One of the general purpose inputs includes a divide by ten prescaler extending its range typically above 600 MHz. The other three inputs will typically count to 65 MHz, with 60MHz guaranteed.

The onboard crystal timebase is selectable under software control for count intervals from 100 nanoseconds to 1 second. For period measurement functions either half-cycle or full cycle measurement and the unit of measure may be selected under software control. The unit for period measurement may be any power of ten from 100 nanoseconds to 1 second. As an example, the 88-UFC can return the length of one cycle of input signal in 1/10's of a microsecond. All measurements provide nine digits of readout. At 600 MHz this provides 1Hz resolution.

The 88-UFC is available in kit form for \$179.00 from International Data Systems, Inc., 400 North Washington Street, Suite 200, Falls Church, Virginia 22046, (703) 536-7373. Payment with order (check or Master Charge) shipped prepaid. COD orders shipped freight and COD charges collect.

CIRCLE INQUIRY NO. 165

Sequence Randomizer-Shuffler

Especially suited for Monte Carlo testing of card games, VPE Model 714 Sequence Randomizer has plug-in configuration for easy interfacing as an addressable memory.

Operation — After a 5 millisecond "shuffling" time, a ready signal from the Model 714 permits "cards" to be read at a 1.5 MHz toggle rate. No repetition occurs within a given "deal." Randomization is based on a random-noise generated selection process. All cards are individually selected. Virtually no correlation on successive "cards" or like selections on successive "deals."

Disc/3

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COMPLETE BUSINESS SYSTEMS

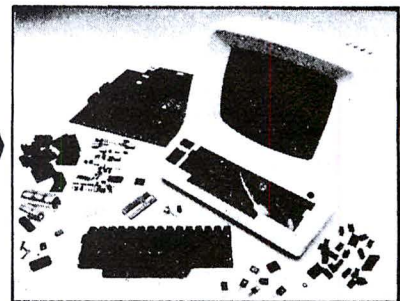
Accounts Receivable, Mailing Labels, Accounts Payable, Payroll, General Ledger, etc. on microcomputers and multi-terminal mini-computers. Call DISC/3, your proven turnkey software specialists for over 3 years, for complete system information. DISC/3 also supplies state-of-the-art business printers.

DEALER INQUIRIES INVITED

EASY TO ASSEMBLE

Lear-Siegler ADM-3 terminal kit with NEW DCA (direct cursor addressing) 24 lines x 80 characters; 64 ASCII upper characters, plus punctuation and control; 5 x 7 dot matrix; EIA standard RS232C and 20mA current-loop (switch-selectable).

\$799.95* with DCA



Look to DISC/3... authorized distributors for IMSAI, Lear-Siegler, Cromemco, Z-80, Centronics Data Computer, Digital Equipment Corp., Data General Corp., TDL, and ICOM.



DISC/3 1840 Lincoln Blvd., Santa Monica, Calif. 90404
Store Hours — Monday-Friday 8:30-5:30 *Prices subject to change.

RUSH ORDER FORM — or Call Disc/3 (213) 451-8911

	KIT*	ASSEMBLED	TOTAL
ADM 3-K with DCA (24 x 80)	\$799.95	\$1099.95	_____
IMSAI 8080 microsystem	\$599.95	\$ 999.95	_____
Box of 10 Diskettes (IBM Compatible)		\$ 45.00	_____

Californians please add sales tax

Signature _____

☐ BankAmericard NO. _____ Expires _____
☐ Master Charge NO. _____



NAME _____ ADDRESS _____
CITY _____ STATE _____ ZIP _____



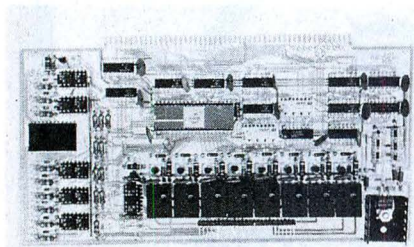
Options Available

- 1) Two "decks" allowing processing of a "deal" while other "deck" is being shuffled.
- 2) Internal sorting and grading of "hands" prior to presentation to system controller.
- 3) A wide selection of "deck" configurations.
- 4) Generation of fresh list of addressable decimal 2-digit random numbers (0-99) on each "deal" for decision making.

For further information contact VPE Electronics, 2020-4 Lomita Blvd., Lomita, CA 90717, (213) 325-8033.

PCI Boards Offer Unlimited Potential

Both the Altair 88-Process Control Interface board and the new, similarly designed 680b-Process Control Interface board enable Altair computers to communicate with the real world of relays, switches, motors, fans, contactors, alarms, solenoids, lights, heaters and many other electromechanical devices. The 680b-PCI and the 88-PCI boards can be used in almost any instance where the computer must control large amounts of power.



Each board has eight relay outputs with SPST operation that are capable of switching 1 amp at 120 VAC. But with external relays added, the amount of power that can be controlled is essentially unlimited. Both boards also have optically-isolated inputs, which can be configured to accept a wide range of input signals.

Two pairs of optically-isolated, software-controlled "handshake" lines are also provided for interfacing with external devices. All lines are isolated and balanced for operation in electrically noisy environments.

For further information, contact MITS, 2450 Alamo S.E., Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 167

Adapter Card Interfaces Per SCI Disc to S-100

The INFO 2000 Adapter now permits easy interfacing to the fastest disc drive available in the low priced line.

The INFO 2000 Adapter card includes circuitry for an additional 3K of EPROM and 1K of fast RAM. The advantage to this is that the user can place his entire operating system and scratch pad in the EPROM and RAM on the adapter and free up all his system RAM for programs. All that is required is that you purchase 4 2708 EPROM and 2 2114 RAM chips. The INFO 2000 Adapter kit can be assembled in one hour.

What the INFO 2000 Adapter owner can now have is a complete operating system (DOS), "intelligent controller," 7K of EPROM, 2K of RAM, and have it all on one card that plugs into the S-100 bus. Kit price for the INFO 2000 Adapter is \$85.00. Deliveries start in July 1977 and if you write us we will send you info on assembled units and other options. Contact INFO 2000, P.O. Box 3196, Culver City, CA 90230.

CIRCLE INQUIRY NO. 168

Computerized Morse Code Reception Package

The package consists of a tone to DC converter module and complete software for the S-100 based 8080 microcomputer. The con-

verter connects to the communications receiver via headphone jacks and to the computer via a parallel I/O port.

The converter contains a phase locked loop for tone decoding and adjustable center frequency and band width controls. Its design is highly immune to impulse noise. Provision for audio and visual synchronization of the incoming signal is provided.

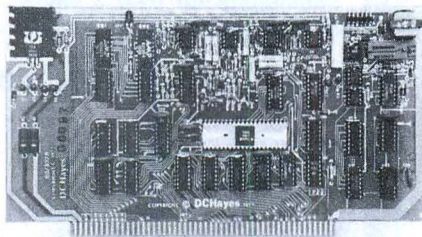
The software adjusts for variations in transmission as each code element is received, allowing for manual or automatic transmission of CW at speeds ranging from 5 to 60 words per minute. Noise and drop-out negating logic is included. Final output of received text is to an SIO port for display to a printer or CRT.

Package price in kit form for the converter, object program and complete documentation is \$95.00. An assembled and tested version lists at \$145.00. Source tapes and complete turnkey packages are also available. On the low end, schematic of the converter, object dump and documentation are available for \$17.00. For further information, contact: Polaris Computer Systems, 3311 Richmond Ave., Houston, Texas 77098, (713) 527-0348.

CIRCLE INQUIRY NO. 169

80-103A Data Communications Adapter

The 80-103A Data Communications Adapter (DCA) was developed to function as an S-100 bus compatible serial interface incorporating a fully programmable modem and Telco interface. These functions are usually accomplished by the use of two separate modules: 1) a serial I/O board, and 2) an external modem. By combining these features on a single board, the 80-103A can offer microcomputer applications significant cost/performance advantages over other implementations.



An S-100 computer such as the Altair* or Im-sai, and a Telco 1001D data access arrangement (DAA) is all you need to control the Adapter and interface to the world-wide dial telephone network. These capabilities bring high powered features to hobby and business applications usually associated with the most sophisticated computer networks and do so at a very low cost.

While software subroutines are provided with the modem, the programmer will find the architecture of the 80-103A extremely simple and programming a straight forward exercise. This device was specifically developed to increase the power and usefulness of microcomputer systems and is now available for your use.

*Trademark of MITS, Inc.

FEATURES

- Fully Programmable Features
- Automated Dialing and Answer
- Originate or Answer Mode
- 110-300 Bit/Sec Data Rates
- Character Format Display
 - Number of Data Bits - 5, 6, 7, 8 bits
 - Number of Stop Bits - 1, 1.5 or 2 bits
 - Parity Generation and Checking
- Echo Suppress Tone Generator
- Self Test for Complete Internal Verification
- Error Detection
- Fully Buffered, Outputs Drive 25 S-100 Bus Loads
- Standard U.S. Frequencies, compatible with Bell 103 type Data Sets

- Full Telco CBT Compatibility when attached to DAA
- Compatible with Existing Teletypes and Time Sharing Modems
- All Digital Modulation and Demodulation. No Adjustments Required.

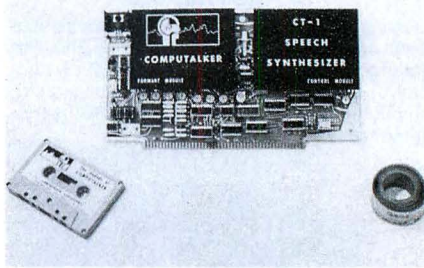
PRICE

Assembled and tested with Manual and 90 day warranty just \$279.95. Printed Circuit and Manual, \$49.95. Manual only \$7.50. For further information contact D.C. Hays, P.O. Box 9884, Atlanta, GA 30319, (404) 231-0574.

CIRCLE INQUIRY NO. 170

Speech Synthesizer

COMPUTALKER CONSULTANTS announces the Model CT-1 Speech Synthesizer, the first microcomputer plug-in speech synthesizer board capable of truly high quality speech output.



The Model CT-1 optimizes the trade-off between low data rate speech and directly digitized speech. Low data rate speech relies on canned definitions for the sound of each phoneme, which produces mechanical sounding speech. Digitized speech, while remaining faithful to the original sound, requires 10K to 20K bytes per second of storage and is inflexible to phonetic manipulation.

With the COMPUTALKER Model CT-1, the sounds are defined in real time under software control. Parameters which represent the phonetic structure of human speech are transmitted to the CT-1 at a rate of 500 to 900 bytes per second, depending on the data comprehension techniques used. This allows the production of highly intelligible and quite natural sounding speech output. Speaker characteristics and language or dialect variations are retained in the output.

The Model CT-1 is a factory assembled and tested board, 5 1/4" x 10", which occupies a single slot on the Hobbyist Standard S-100 bus. It requires a block of 16 output locations, one byte (8 bits) each, relocatable to any HEX boundary via an on-board selector switch. Power requirements are +8 V unreg. (or +5 V reg.) at 170 mA typ., 250 mA max, and ±12 V reg.) at 85 mA typ.

CT-1 Speech Synthesizer (unit quan) \$395.00

CSR1 Synthesis-by-Rule software 35.00

Delivery is from stock to 45 days ARO. Dealer inquiries invited. For further information, contact: COMPUTALKER CONSULTANTS, P.O. Box 1951, Santa Monica, CA 90406. (213) 392-5230.

CIRCLE INQUIRY NO. 171

The Tarbell Floppy Disc Interface

The Tarbell Floppy Disc Interface is a programmed-data-transfer (not DMA) device. It plugs into your IMSAI or ALTAIR* computer, and is designed to work with a variety of standard-size floppy disc drives. It includes a 32-byte ROM bootstrap program, which is automatically started when the computer RESET button is pushed, and which switches itself out after the bootstrap has run. In this way, no part of your memory needs to be dedicated to ROM. The interface runs at the standard speed of 250,000 bits per second, and the normal formatted capacity per diskette is 243 kilobytes. Places for two connectors are provided on the board, and one 50-pin connector is included in

the interface kit. There are four extra IC slots to allow you to do your-own thing, and the connector pins come out to jumper pads, so you can adapt to different drives. The manual has the connections detailed for popular drives.

Since Tarbell Electronics does not wish to get into the business of selling complete systems, we encourage you to buy your floppy disc drive from the manufacturer directly. If you add up the prices, however, you can see that a complete floppy disc system including software and hardware can be had for less than a thousand dollars. Note that the Tarbell Floppy Disc Interface is not designed to work with double-density or mini-floppies, although it will work with multiple drives.

For prices, delivery time and further information, contact Tarbell Electronics, 20620 South Leapwood Ave., Suite P, Carson, CA 90746.

*Trademark of MITS Inc.

CIRCLE INQUIRY NO. 172

Adapter PCB Provides S-100 Bus Interface for PerSci's Floppy Disc Controller PCB

- ACS's new PSFDC adapter PCB provides
- PerSci Disc Controller Logic Interface
- PerSci Disc Controller Physical Mounting
- Disc Controller PCB to Disc Drive Connector Interface Compatible with PerSci Interface Cable
- Disc Controller PCB to S-100 Connector Interface without any modification to Disc Controller PCB
- Up to 7K 2708 EPROM Storage (can be used to store driver routine and bootstrap loader & monitor program)
- 1K Static RAM Storage

On board address options include memory mapped I/O addressing or isolated I/O addressing for the Floppy Disc while the 8K optional memory can be addressed to any 8K block of memory.

The PerSci Disc Controller PCB with adapter connectors and PCB edge connector fingers allow the controller board to be plugged into the S-100 adapter board without any modifications.

The S-100 PSFDC adapter PCB includes 4 edge connectors and 2 PCB edge connectors.

PRICE

- PSFDC (includes 4 edge connectors & 2 PCB edge connectors) \$75.00
- PSFDC and all parts except EPROMS, unassembled (excludes sockets for RAM & EPROM IC) \$150.00
- PSFDC and all parts except EPROMS, unassembled (includes sockets for all DIP ICs) \$160.00
- PSFDC completely assembled & tested \$250.00

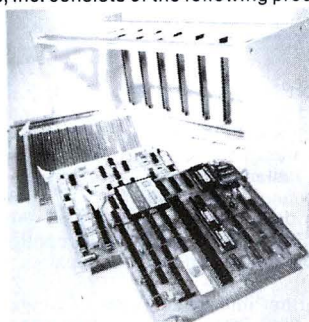
Note: Add \$3.00 for handling & shipping. Calif. add 6% sales tax.

Automated Computer Systems, 2361 E. Foot-hill Blvd., Pasadena, CA 91107, (213) 449-0616.

CIRCLE INQUIRY NO. 173

ZILOG-Z80 MCB Compatible Hardware

This new family of ZILOG-Z80 MCB compatible peripheral and accessory items from Signal Labs, Inc. consists of the following products.



MAD-ONE: Multiple channel analog interface card with software programmable gains and commutating memory. Priced from \$595.

MODEL 606: Programmable gain amplifier and filter card with dual channel inputs. Priced from \$395.

MODEL 602: Universal logic interface card available w/wo wire-wrap pins. Priced from \$75.

MODEL 605: Extender card. \$95.

MODEL 604: Card cage. Priced from \$210 with 8 card slots.

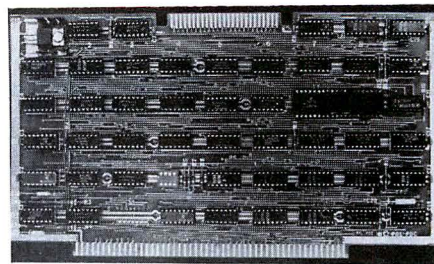
All items available from stock. For details call Bill Chidester at (714) 634-1533. Signal Laboratories, Inc., 202 N. State College Blvd., Orange, CA 92668.

CIRCLE INQUIRY NO. 174


Software Supported Floppy Disc Controller for 8080 Based Systems

The μ PAL 1016 floppy disc controller provides a high quality, low cost controller for S-100 bus compatible microcomputer. The unit can handle up to eight discs to achieve a large data storage base. The user is not left flopping in the breeze for lack of software support. A sophisticated software package, tapes and

listings, is available for \$25. The controller, assembled with sockets, sells for \$418. A controller and a single disc drive are available for \$995.



The single card controller contains a DMA interface. Formatting capabilities are provided. IBM 3740 and other formats are possible, as



COMPUTER COMPONENTS

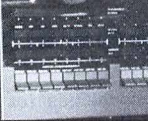
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100 Pin Connectors	5.	—
20 Card Guides	3.50	—
40 Card Guides	6.00	—
PIC-8 Interrupt/ATC	125.	170.
GP-88 Proto Board	39.	47.
EXT Extender Board	39.	49.
PIO6-6 6 Part Parallel	164.	229.
PIO6-3 3 Part Parallel	139.	180.
PIO4-4 4 Part Parallel	156.	211.
PIO4-1 1 Part Parallel	93.	123.
PIO Cable For PIO4-4/1	22.	—
SIO2-2 2 Part Serial	156.	211.
SIO2-1 1 Part Serial	125.	175.
Cable A For SIO and MIO	18.	—
Cable C 4.5' EIA Cable	25.	—
Cable R For PIO6-3/6	35.	—
Cable S For PIO6-3/6	25.	—
MIO Multiple I/O	195.	295.
Cable M Cassette Recorder Cable	12.	—
FDC2-2 Dual Floppy Drive	—	2390.
FDC2-1 Single Floppy Drive	—	1295.
FDC Drive Only	399.	1095.
FIF(1) Floppy Controller	599.	599.
FIF(2) Floppy Controller Only	599.	799.
PTR300A Line Printer	—	2610.
PTR300B 80 Column 300 LPM Line Printer	—	3656.
LIF(1) 132 Column 300 LPM Line Printer Controller	399.	599.
LIF(2) L.P. Controller Only	599.	799.

TTL PRODUCTS

7400	.16	7494	1.00
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7405	.20	74105	1.00
7406	.33	74107	.40
7407	.40	74109	.50
7408	.25	74110	.50
7409	.25	74116	2.00
7410	.20	74121	.40
7411	.25	74122	.50
7412	.33	74123	.60
7413	.50	74125	.60
7414	.99	74126	.60
7415	.33	74128	.75
7417	.33	74132	1.00
7418	.33	74141	.75
7420	.20	74145	1.20
7421	.33	74147	2.50
7422	.50	74148	2.20
7423	.33	74150	1.50
7425	.33	74151	1.20
7426	.24	74153	1.00
7427	.37	74154	1.50
7428	.50	74155	1.00
7429	.40	74156	1.00
7430	.25	74157	1.00
JS-1 Joystick	.65	.95	
WWB Wire Wrap Board	35.	45.	
7432	.33	74160	1.20
7433	.50	74161	1.10
7437	.33	74162	1.30
7438	.33	74163	1.10
7439	.50	74164	1.30
7440	.20	74165	1.30
7441	1.00	74166	1.40
7442	.50	74167	4.00
7443	1.00	74170	2.25
7444	1.00	74172	7.50
7445	1.00	74173	1.50
7446	1.00	74174	1.35
7447	1.00	74175	1.30
7450	.20	74176	1.00
7451	.20	74177	1.00
7453	.20	74178	2.00
7454	.20	74180	1.10
7460	.20	74181	1.25
7470	.50	74182	1.00
7472	.33	74184	2.00
7473	.40	74185	2.30
7474	.40	74188	4.00
7475	.50	74189	4.00
7476	.40	74190	1.30
7480	.75	74191	1.30
7482	1.00	74192	1.00
7483	1.00	74193	1.00
7485	1.20	74194	1.50
7486	.33	74195	1.10
7488	3.50	74196	1.30
7489	2.00	74197	1.10
7490	.50	74198	2.00
7491	.50	74199	2.00
7492	.40	74200	2.00
7493	.40	74279	1.25

SOLID STATE MUSIC KIT ASSEM.

MB6A 8K RAM	250.	300.
MB3 1702A Storage 4K	65.	95.
MB6 Bare Board 8K RAM	35.	—


CROMEMCO

BYTESAVER (No EROM)	145.	215.
BYTESAVER with EROM	195.	265.
DAZZLER Color TV Driver	215.	315.
D + 7A D-A, A-D Module	145.	215.
Z2 Computer	595.	995.
JS-1 Joystick	.65	.95.
WWB Wire Wrap Board	35.	45.

8080 SUPPORT

8080A	19.00	8255	15.00
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CIRCLE INQUIRY NO. 82

well as error detection features. Operating under the DFM 80 portion of the software package, the user need only be concerned with:

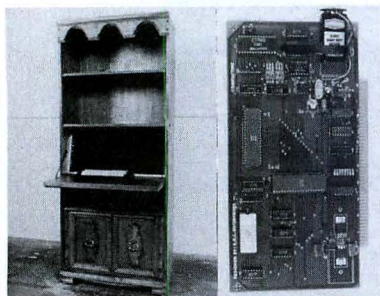
- 1) The name of the file
- 2) The operation to be performed, and
- 3) The physical disc upon which the file resides.

In addition, the software package contains a monitor, debugger and bootstrap loader programs. A SYSGEN program formats discs and establishes linkages to the operating system. For further information, contact: Processor Applications, Ltd., 2801 East Valley View Ave., West Covina, CA 91792, (213) 965-8865.

CIRCLE INQUIRY NO. 175

Digital Clock/Calendar and 40-Function Scientific Calculator on a Single PC Board

This S-100 Bus Compatible PC Board marketed by COMPU/TIME of Huntington Beach, California provides two independently separate functions on a single PC Board.



The DIGITAL CLOCK/CALENDAR function has a crystal-controlled time base for providing date or time output in real time for purposes such as time and date stamping of output listings, memory dumps, or CRT Display. Two settable coincidence counters are incorporated to

provide elapse time capabilities for use in alarm or timing applications. Once set, the CLOCK/CALENDAR does not require re-initialization. If power is shut down, a battery backup system is provided.

The 40 FUNCTION SCIENTIFIC CALCULATOR provides the microprocessor with a hardware solution to floating point, trigonometric, and algebraic problems as well as the basic math functions. Big savings in memory can be realized and made available for other tasks while the hardware performs intricate computations or general mathematics via the calculator array.

COMPU/TIME is available in three configurations:

1. Both, time/date and calculator capabilities model CT100 - kit price \$199.00.
2. Time/date only (coincidence counters are included). Model T102 - kit price \$165.00.
3. Calculator capability only. Model C101 - kit price \$149.00.

These boards are also available completely assembled and tested. Each order includes documentation parts list and software examples so that implementation can be accomplished with a minimum of effort.

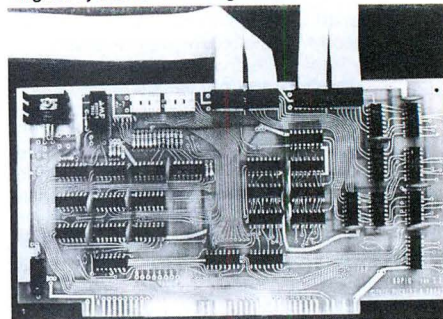
For further information contact: COMPU/TIME, P.O. Box 417, Huntington Beach, CA 92648, (714) 638-2094.

CIRCLE INQUIRY NO. 176

Yet Another S-100 I/O Board?

The Pickles & Trout BDPIO (BiDirectional Parallel I/O) is S-100 compatible and has as an accessory an IEEE-488 (HP-IB*) adapter. Six of the eight ports are on a bidirectional bus which includes six interrupt lines and an uncommitted line for power or other user selected function. This bus allows a small number of lines to service devices which require several ports, such as the Digital Group cassette controller. The six ports require only one cable assembly and use a single 25 pin D connector. An external junction box is available which decodes ad-

dresses and provides additional signal buffering for systems with long cables.



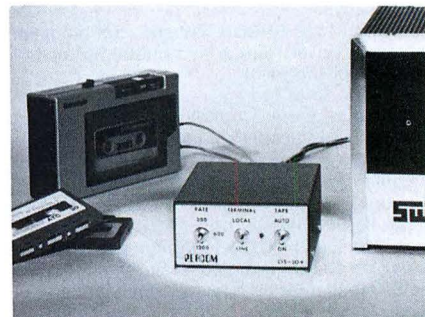
The BDPIO is available fully assembled and tested for \$165.00. For further information write to Pickles and Trout, P.O. Box 2270, Goleta, CA 93018.

*Hewlett-Packard Interface Bus

CIRCLE INQUIRY NO. 177

Cassette/Terminal Interface for SWTPC 6800 Operates at 120 Bytes per Second

Designated the CIS-30+, the dual function unit interfaces cassette data at a user selectable 30, 60, or 120 bytes per second, and provides RS-232 interfacing at 300, 600, or 1200 baud.

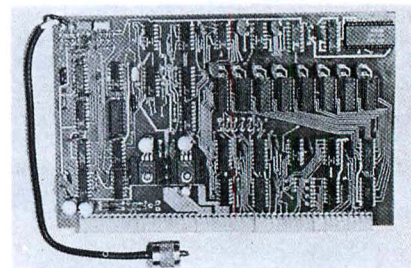


The CIS-30+ kit is \$69.95. Assembled, it costs \$89.95. An instruction manual is included. For further information contact PerCom Data Company, Inc., 4021 Windsor, Garland, TX 75042, (214) 276-1968.

CIRCLE INQUIRY NO. 178

Video Board

Ultra speed output. Generates 16 lines by 32 upper case characters. (Jumper selector for 16x64 for use with 10 MHZ video monitor.)



Dual port 1K (1024 bytes) RAM (can be jumpered to the beginning of any 1K memory segment) which the processor can read or write as though the memory was part of the system. Instantly displayed as written. Text scrolling and cursor generated by software. (Display driver software available.) Full interlaced EIA video output (crystal controlled). Adjustable density and left hand margin. Each \$249.

For further information contact Gimix Inc., 1337 W. 37th Place, Chicago, IL 60609, (312) 927-5510.

CIRCLE INQUIRY NO. 179

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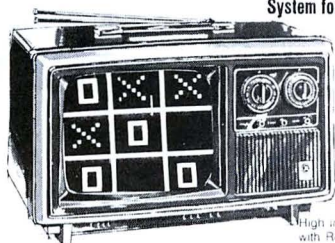
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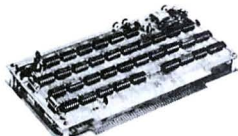


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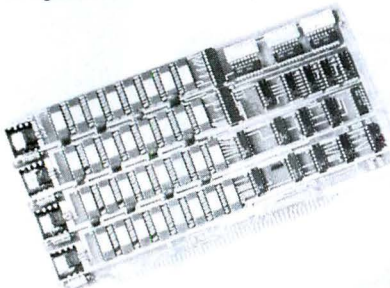
*All teletypes mentioned above are "off lease" units. Our contract with LEASCO guarantees that they be above serial number 300,000 and working when delivered. If for any reason it does not work upon arrival, you may return it to your nearest LEASCO Service Center for free repair. After that, there is no warranty expressed or implied. All units should be complete with reader, punch, pedestal stand, chad box, and copy holder. FOB Germantown, MD (You pay all shipping charges). We are passing on to our customers the advantage of our large OEM contract — if you don't need the TTY you can subtract \$600.00 from the above prices or apply this toward purchase of a DECwriter or Diablo.

**Polymorphic System 16 prices have gone up to \$2250.00. We have a limited number of System 16's at the old price \$1995.00.

Memory Cards

The 16K Space Byte

A fully static, state of the art RAM, utilizing the TMS-4044 (4K by 1 bit static) from Texas Instruments. The space byte is addressable in 4K blocks at 4K boarders with DIP switches; in addition to memory write protect and disable, also controllable by DIP switch in 4K blocks. (Write protect & disable (phantom) also controllable with software by simple jumper connection)-battery back-up capability with either direct connector, or jumper connection through bus.



The 16K space byte is fully S-100 bus compatible, with ALTAIR™, Vector One™, IMSAI, Polly 88, SOL-20, AM-100 (DMA disc). Since the 16K space-byte is fully static, there are no incompatibility problems as encountered by dynamic or quasi-static type devices.

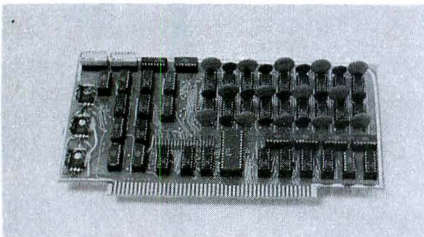
Currently with 16K space byte is being supplied with 450ns chips, but is compatible with the Z-80, (clocked at 2.5MHz), 250ns devices will be available at a slightly higher price.

The 16K space byte is offered fully assembled, burned in and tested with a solder masked and silk screened G-10 P.C. board, \$599. Available through computer dealers everywhere. Contact The Pace-Marker Group, 1720 Pontius Ave., Suite 201, Los Angeles, CA 90025, (213) 468-8080.

CIRCLE INQUIRY NO. 180

S-100 Bus 16K/32K Parity RAM

A new RAM board for the microprocessor user and OEM introduces the concept of parity memory to the S-100 community in its first implemented form. The board is available in 16K or 32K sizes, with or without parity. Only prime, high speed components are used in its construction.



Each board is supplied assembled, tested, burned in and guaranteed for one year. Additional features include: ROM lockout, "shadow" control, on board refresh with no wait states, full or partial write protect, and a MIL spec PC board. The board features 16K dynamic RAM chips with 250 ns access time, and is available on a guaranteed delivery basis.

S100/16K	\$485.00	S100/32K	\$885.00
S100/16KP	\$560.00	S100/32KP	\$990.00

For further information, contact CreaComp Systems, Inc., 4175 Veterans Highway, Ronkonkoma, NY 11779, (516) 585-1606.

CIRCLE INQUIRY NO. 181

General Purpose Memory Board (2102-M-816)

This memory board is designed for maximal system flexibility: it can be (jumper) configured in a variety of ways to become compatible with any system, including the possibility to change from 8-bit word to 16-bit word machines.

16K 8-bit words or 8K 16-bit words
RAM 2102 or any other pin compatible chip

Interface flexibility — An additional wire wrap area for at least two 24-pin chips and twelve 16-pin chips is reserved for system dependent on TTL.

Edge connector flexibility — The bottom edge of the 2102-M-816 contains a full row of (72/144) freely allocatable pin positions; thus the necessary pin dedication is jumper selectable for different bus configurations. Any type or number of connectors can be inserted into our universal edge by simply cutting off (with a small hand saw) any undesirable pin position (for instance one S-100 (50/100) connector or two separate (22/44) connectors).

Technical characteristics:

- Width: 12"; Height: 7"
- 128 chip positions for 16 pin RAM
- Printed circuitry for linkage of the following pins in parallel:

pins 1 to 8, 14 to 16

Power and ground: pin 9 and 10 (heavy duty lines)

Select: pin 13 of each of the 8 chips within the same bank (row); there are 16 banks.

Data Read/Write: pin 11 and 12 are of the 8 chips within the same column; there are 16 such columns which can be jumpered pairwise for 8-bit systems

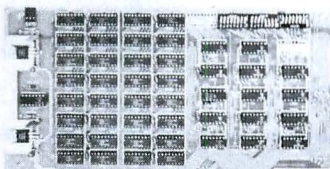
— Gold plated edge connectors

Delivery: 0-30 days after check is cleared. Payable by check or money order on any U.S. or Canadian bank. Price: Board, \$60.00. Assembled with sockets, \$125.00. Assembled with sockets and chips: 2102, \$310.00; 21L02, \$350.00. Written orders only! Prices may change without notice. For further information contact Systemathica Consulting Group Ltd., P.O. Box 488, Pickering, LIV 2R7, Ontario, Canada.

CIRCLE INQUIRY NO. 182

JUMP START

An S-100 bus compatible 4K RAM board which will cause the system to automatically jump to any preset byte of memory after power-up or reset. A destination address anywhere in memory is set on sixteen of the DIP switches conveniently located at the top of the board. After power-up or reset the JUMP START board automatically causes the system to jump to this address. The board is designed to allow automatic execution of bootstrap or monitor programs without any operations from the front panel.



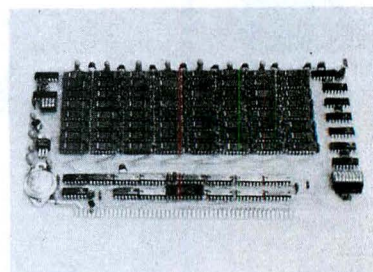
Low power, 450 ns, 1K static RAM's are mounted in sockets on a PC board with solder mask on both sides. A printed legend and complete documentation ease assembly operations. The board includes memory write pro-

tect logic which can be set from the front panel or from an on-board DIP switch. Battery back-up circuitry and connectors are included. The kit price of JUMP START is \$145, or \$190 assembled and tested. For further information contact: Micromation Inc., 524 Union St., San Francisco, CA 94133, (415) 398-0289.

CIRCLE INQUIRY NO. 183

64K RAM Board Expands Computer Memory

A fully-tested 64K RAM board is being offered by Extensys Corp. of Sunnyvale, CA. This board meets S-100 computer interface specifications, including Altair and Im Sai units, and allows memory addition up to 1,048,576 bytes.



The 5x10" PC board contains 65,536 bytes and has hardware provision for bank switching to add over 1 million bytes—far beyond normal microprocessor capacity. The board also allows memory address to be set in 8K byte increments and provides hardware-write protection in 16K byte increments. Voltages are +12 at 300mA, +5 at 750mA, and -5 at 1mA. Cycle time is 500 n sec, with 400 n sec access time. Memory overlap protection is provided to ensure no conflict with existing memories. All boards are fully assembled, tested, and burned in.

The 64K RAM board is \$1,495. A 32K board is offered at \$895, and a 48K board at \$1,195.

To order direct, or for further information, contact: Extensys Corp., 592 Weddell Drive, Suite 3, Sunnyvale, CA 94086, (408) 734-1525.

CIRCLE INQUIRY NO. 184

16K Static RAM

A 16K Static memory card for the S-100 bus features fully buffered bus, low-power Schottky TTL logic. Card does not require a front panel for generation of memory write signal. Tested in Altair and Im Sai; compatible with TDL and SD Sales Z-80 CPU's.

4K 22-pin static memory chips. Low-profile sockets for all chips. Gold-plated contacts; solder mask; assembly manual. Extra address lines provided. No refreshing required. Low power consumption. 220 ns chips.

Board is available in kit or assembled. Assembled boards are tested and warranted for 30 days parts and labor. Kit price: \$365. Assembled price: \$450.

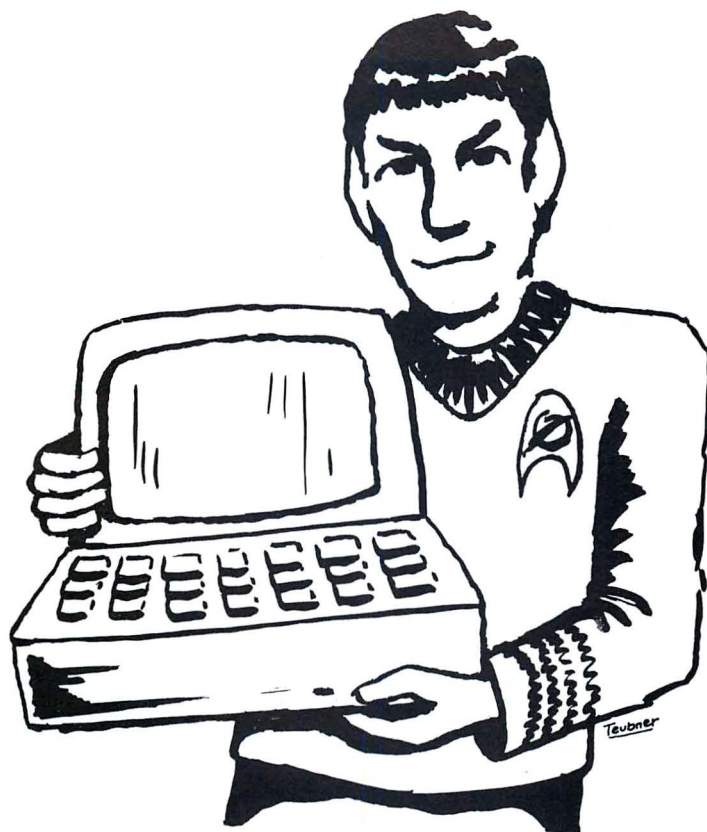
For further information, contact Vandenberg Data Products, P.O. Box 2507, Santa Maria, CA 93454; (805) 937-7951.

CIRCLE INQUIRY NO. 185

16K PROM Card Operates at 4 MHz

The new PROM card will operate with the fastest microcomputers because of its 'address anticipation' feature which makes it usable with the 4 MHz clock rate of Cromemco's high-performance Z-2 microcomputer system. Address anticipation means that there are no wait states required in usual operation.

The new model 16KPR also incorporates Cromemco's bank select feature which enables the board to be used in large memory



such a deal!

I've been using computers for a long time and I consider myself somewhat of an expert in the field, or space for that matter. (hee hee) Believe me, you don't run a starship by the seat of your pants. Whizzing through the universe stalking Romulans and Klingons requires equipment of the highest quality. Why, just the other day I was talking to the Captain. "Jim." I said, "We must lay in a course for *COMPUTER PLAYGROUND*. I need another one of their 8-K Static Memory Boards and I simply can not function without an Apple II Computer."

"Why can't we just swing by Starbase 4 instead?" He asked.

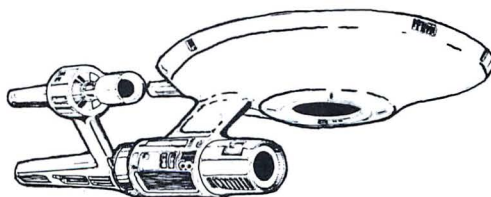
"Why, that would be highly illogical!" I explained. "Where else but at *COMPUTER PLAYGROUND* do you get such courteous service and such a wide selection at competitive prices?"

He agreed, and we altered our course for *COMPUTER PLAYGROUND* at Warp Factor 10. Seconds later, we arrived. They had everything that I needed. Why, just look at what they have to offer . . .

**Apple I & II
Vector Graphics
Cromemco
Motorola Monitors
Datanetics Keyboards**

**Imsai 8080 System
K.I.M. System
Intel 2708
Integrated Circuits
Specialists in 6502 Systems**

Not to mention their personalized instruction courses in 8080 assembly language for \$40.00 and Basic language classes for only \$20.00.



Come, visit the future at . . .
**Computer Playground
6789 Westminister Avenue
Westminster, California 92683
(714) 898-8330**

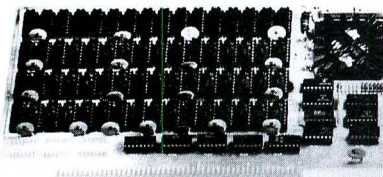
systems of up to 8 memory banks of up to 64K bytes each.

Price for the new 16KPR in kit form is \$145. For the assembled card price is \$245. PROMs are not included. However, 2708's are available from Cromemco. Delivery is from stock to 30 days. For more information contact Cromemco, Inc., 2432 Charleston Road, Mountain View, CA 94043, (415) 964-7400.

CIRCLE INQUIRY NO. 186

Logos 1 Memory Board

The Logos 1 is an 8K static low power memory board designed for the popular S-100 bus. It features dip-switch selectable addressing on any 1K boundary and a hardware memory protect circuit that allows protection as 1-8K memory block, 2-4K blocks, 4-2K, 8-1K, 16-512 byte, or 32-256 byte blocks.



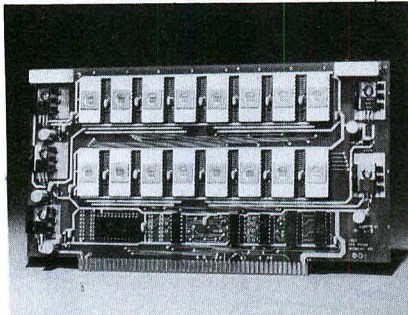
The Logos 1 runs at full speed with no wait states. All address lines, data in and data out lines are fully buffered. On board battery back-up circuitry is included. The printed circuit board is high quality glass with plated through holes, gold edge contacts, soldermask and silkscreen for easy assembly. Typical power consumption is 1.4A @ 8V. The kit includes low profile sockets for all ICs and is priced at \$248.00, assembled \$298.00. Special introductory price is \$219.95 kit.

For further information contact Advanced Microcomputer Products, Inc. P.O. Box 17329, Irvine, CA 92713, (714) 558-8813.

CIRCLE INQUIRY NO. 187

16K EPROM Memory Board Kit

Designed to plug into the popular S-100 bus, the memory board holds 16 2708 EPROMs. Unused 4K sections can be disabled to allow RAM to exist within the board's address space.



The board also has provisions for a wait state to allow it to run on a Z80 system. The Kit comes complete with sockets for all IC's. (Less EPROMs). Quantity discounts and dealer prices are available, contact factory. Price, \$85.00 available from stock. For further information contact IBEX, 1010 Morse Ave., Suite 5, Sunnyvale, CA 94086, (408) 739-3770.

CIRCLE INQUIRY NO. 188

First of a Series of Music Boards, S-100 & Parallel Versions Available

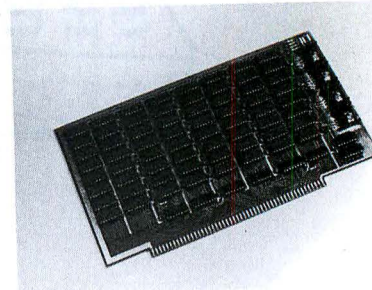
The 10-5-9 and 10-5-10 Quad Chromatic Pitch Generator boards are designed to be a low-cost start in computer-controlled music generation. The single board Pitch Generator produces one to four tones simultaneously, two boards can be used to produce eight simultaneous

tones in stereo. Each of the four tones are separately controlled and can produce any of 96 tones which form an 8 octave range. This covers the entire standard piano range, plus 8 higher pitches. Special connections allow later expansion with accessory boards to control various sound parameters. Using the optional on-board crystal oscillator or a 2 MHz source (external or pin 49 on the S-100 bus) all pitches are within 0.1% of the A = 440 Hz standard. The 10-5-9 is S-100 compatible, and the 10-5-10 is compatible with parallel output ports. Kit prices for both versions range from \$111 to \$159 (depending on the number of simultaneous tones), the assembled price is \$185. Oscillator is an additional \$16. Available for product evaluation: data sheet (free), demonstration record (\$1), and owner's manual (\$3 plus \$1 postage). ALF Products Inc., 128 South Taft, Denver, CO 80228, (303) 234-0871.

CIRCLE INQUIRY NO. 291

AE 8KS RAM Board

Plug compatible with the ALTAIR 8800 and IMSAI 8080, or any other system using the "S-100 Bus."

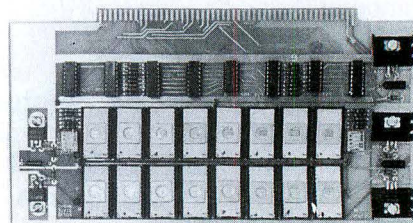


Low power Schottky support chips. DIP switch selection of memory address assignment and memory protect. Low profile sockets provided for all RAMs and ICs. Gold plated edge connector contacts. Phantom can be implemented. Kit price, \$189.00. Assembled, \$299.00. For further information contact Associated Electronics, 1885 W. Commonwealth, Unit G, Fullerton, CA 92633, (714) 879-7541, 879-7707.

CIRCLE INQUIRY NO. 190

MB-8 16K EPROM Memory Board

The MB-8 2704/2708 EPROM board is S-100 bus compatible and contains DIP switches for memory address assignment selection, 8K or 16K block address selection, and number of weight cycle selection (1 to 4).



The MB-8 EPROM board is mechanized with low power Schottky support chips and includes low profile sockets for all IC's. The PC board is \$85.00 without EPROMs.

For further information contact Solid State Music, 2102A Walsh Ave., Santa Clara, CA 95050, (408) 246-2707.

CIRCLE INQUIRY NO. 191

"NOW THERE ARE TWINS"

the **BYTE SHOPS** of South Florida

WE OFFER: IMSAI, Processor Tech, Vector Graphic, Tarbell, Seals, Compucolor, North Star, Apple, Oliver Audio, SWTP, iCOM, Syntec Design, Micro-Term, Vector, AV, Dynabyte, Cromemco, Scientific Research and more.

BOOKS, DIAGRAMS, SOFTWARE: We carry more than a complete library to answer your every need.

SUPPOSE YOU NEED A SYSTEM? We have specialists waiting to help you. They can design a system for most anyone. In addition, we have classes and workshops to help you keep pace with this expanding industry.

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(305) 561-2983
Dial 561-BYTE

CIRCLE INQUIRY NO. 65

AM-100

You have to SEE it to BELIEVE it!

The Alpha Microsystems AM-100 is LIGHT YEARS ahead of everything else you've seen so far in the low cost computing field.

For a FRACTION of what you'd normally pay for the SOFTWARE ALONE, you get a 16-bit processor with ALL of these BIG-SYSTEM capabilities:

MULTI-TASKING, MULTI-USER TIMESHARING

- ☆ DEVICE INDEPENDENT I/O
- ☆ ADVANCED FILE STRUCTURE
- ☆ POWERFUL SYSTEM COMMANDS
- ☆ SOPHISTICATED TEXT EDITOR
- ☆ FULL MACRO ASSEMBLER
- ☆ LINE PRINTER SPOOLER
- ☆ RE-ENTRANT, MULTI-USER BASIC
COMPILER
- ☆ LARGE UTILITIES LIBRARY

**Yet, with all this it's still compatible
with the S-100 BUS!**

If you like the Decsystem-10 operating system, if you like TECO . . . if you like the PDP-11 instruction set . . . you'll LOVE the AM-100!

**ONLY
\$1495
IN STOCK NOW!**

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PASADENA, CA. 91101
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Saturday & Sunday, 12:00 — 5:00;
Closed Mondays



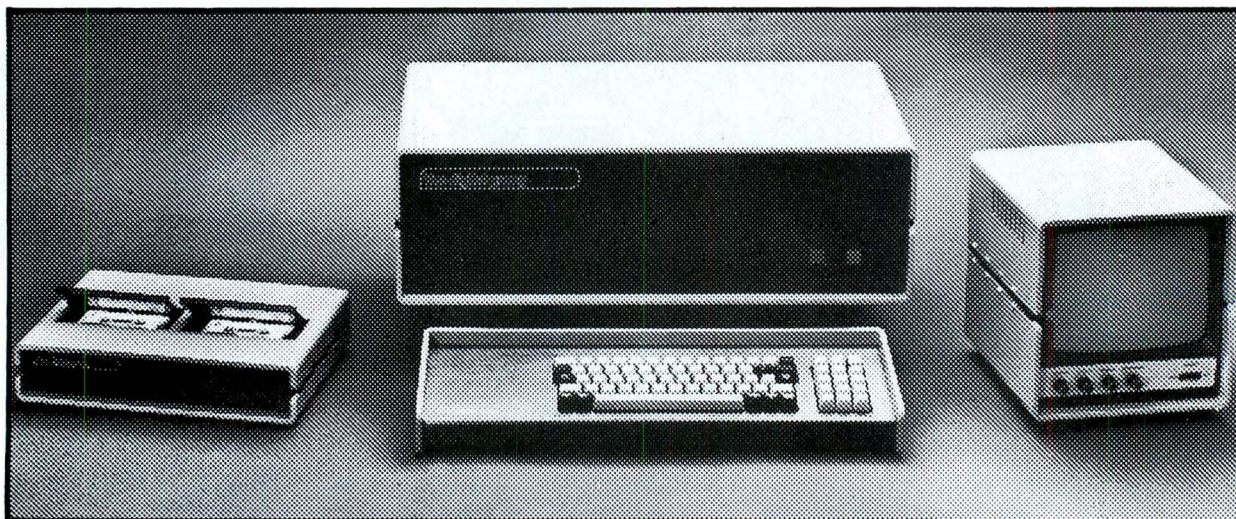
Our Digital Group Package Plan

Completely Assembled and Ready To Run!

Unpack It. . . Plug It In . . . You're Up and Running!

No soldering — We do it for you.

No debugging — We do it for you.



Z80 Computer with Keyboard and Video Monitor*

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Z80 CPU

Video and Cassette Interfaces

I/O System

Memory

Power Supply & Cabinet

64 character screen

***everything!!**

Z80 Package 1 With 10K Memory (fully assembled) \$1480.00

Z80 Package 2 With 18K Memory (fully assembled) \$1710.00

Z80 Package 3 With 26K Memory (fully assembled) \$1933.00

***Optional Complete Software Package. \$65.00**

—includes—

Z80 Extended Basic

Z80 Tiny Basic

Z80 Assembler

Z80 Disassembler

Z80 Text Editor

Star Trek

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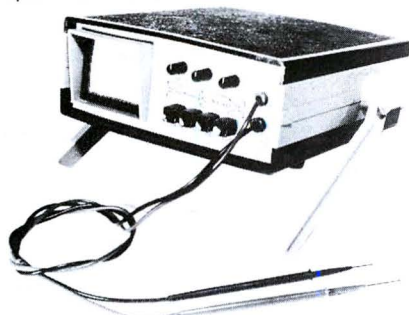
(213) 327-2118

RICH TRAVIS

Test Equipment

Huntron Tracker

A test instrument for trouble shooting solid state components—in or out of circuit—is now available from Huntron Instruments, Inc. The HUNTRON TRACKER speeds isolation of defective devices, reduces equipment down time, eliminates wasteful discards and lowers repair labor costs.



A special comparator function permits printed circuit or IC testing against known good units, cutting trouble test times dramatically. Visual scope displays indicate the condition of IC's, bipolars, F.E.T.'s, diodes, diodes back-to-back, L.E.D.'s, zeners, unijunctions, seleniums, etc with shunt resistances as low as 10 ohms and operational power factors that range from only .0019 watts to .284 watts.

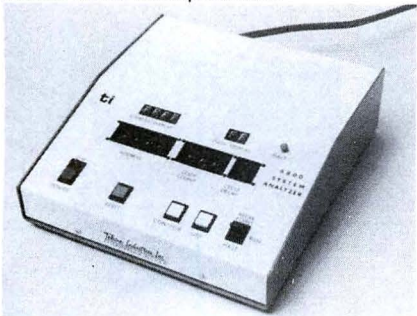
A 2" x 3" scope, two highly insulated non-polar leads and three ranges make the Huntron Tracker a safe, simple, reliable, and cost effective test instrument for repair bench or original equipment and component manufacturers.

For further information contact Huntron Instruments, Inc., 15123 Pacific Highway North, Lynnwood, WA 98036.

CIRCLE INQUIRY NO. 192

Microprocessor 6800 System Analyzer

The 6800 system analyzer is designed to assist the microprocessor system designer and is capable of operation with any Motorola MC6800 series microprocessor.



The unit features individual hexadecimal address and data displays, thumbwheel selec-

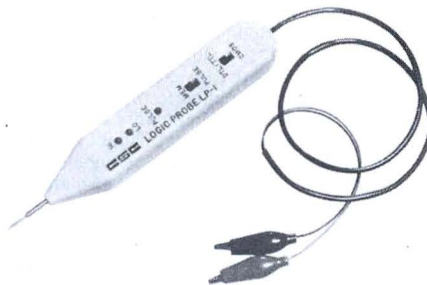
table address, loop count, and cycle delay for use in both break point and halt modes. Special operational features include single step, which allows the debugging of software by manually stepping through the program, and break point which allows the program to execute through until reading the selected address at which time the program enters single step. Single unit quantity price \$995.00.

For further information, contact Telcon Industries, Inc., 5701 N.W. 31st Ave., Ft. Lauderdale, FL 33309, (305) 971-2250.

CIRCLE INQUIRY NO. 193

The Logic Probe-1 LP-1

Model LP-1 Multi-Family Logic Probe is a low-cost, pocket-sized, multi-function test instrument for digital applications. In a single housing not much bigger than a fountain pen, the LP-1 combines the functions of a pulse detector, pulse stretcher and memory circuit, allowing engineers, technicians and hobbyists to get an instant picture of static and dynamic circuit conditions with most popular logic families. The Logic Probe's low price of \$44.95, combined with its high performance and great versatility, brings precision digital testing within the range of hobbyists, engineers and the field technician. LP-1's ability to detect pulses as short as 50 nanoseconds, coupled with its stretching and latching ability, means that one-shot, low-rep-rate, narrow pulses—nearly impossible to see, even with a fast scope—are now easily detectable and visible.



The user simply connects the clip leads to the circuit's power supply, sets the Logic Family switch to the proper position (TTL/DTL or CMOS) establishing the correct logic level for the family under test and touches the probe tip to the circuit mode. Two level detector LED's—HI (logic "1") and LO (logic "0")—plus a blinking PULSE detector LED display signal activity at the node under test. By using the Pulse/Memory switch, the user can select indication of pulse transitions or storage of low-rep-rate or single-shot events.

In operation, logic "1" levels trigger the HI LED; logic "0" levels trigger the LO LED, and in the PULSE position of the Pulse/Memory switch, the PULSE LED blinks at a 3-Hz rate to

indicate pulse transitions. This pulse-stretching feature allows high-rep-rate transitions to be easily observed. At high frequencies, LP-1 will also indicate whether or not signals are symmetrical. Pulse trains with the duty cycles less than 30% will activate the LO LED, in addition to the PULSE LED, while duty cycles of more than 70% will activate the HI LED.

LP-1 is housed in a rugged molded plastic case with built-in strain-relieved power cables and reverse-polarity/over-voltage protection. For further information, contact Continental Specialties Corporation, 44 Kendall Street, Box 1942, New Haven, Ct. 06509, (203) 624-3103.

CIRCLE INQUIRY NO. 194

45-B Logic Analyzer

The 45-B is a portable, hand held instrument that gives the user the ability simultaneously to display 4 channels of digital logic waveforms on a conventional single trace scope.



With the 4 channel display, the user can readily observe the complex timing relationships present in digital circuitry.

On the design bench, the 45-B is especially helpful in hardware debug. The engineer can verify relative input and output conditions, as well as observe circuit operation with respect to clocks and various timing pulses. This greatly reduces time spent bringing R&D projects to the operational level.

In the field, the 45-B is an inexpensive method of extending the capabilities of conventional scopes. This provides for more complete field troubleshooting and results in more on site repairs.

Battery and AC operation make the 45-B at home on the bench or in the field. The 45-B can be used with a wide range of logic families, including TTL, DTL, RTL, and CMOS, without having to set threshold.

All these features, including a 9 Volt battery and AC adapter for \$149.95 make the 45-B truly a cost effective tool.

For further information contact: Digital Broadcast Systems, Inc., 4306 Governors Dr., Huntsville, Alabama 35805, (205) 837-2183.

CIRCLE INQUIRY NO. 195

Power Supplies

A 4 Output Switching Power Supply Priced Competitive with Linears at 50 Watts!

A 4 output 50 watt switching power supply to drive microcomputer systems is being offered by BOSCHERT ASSOCIATES. The standard supply has outputs of +5V@6A, ±12V@1A and -5V@1A, with a maximum power of 50 watts total. Other voltages are available in OEM quantities. This power supply

offers the heat, weight and size advantages of a switching power supply with no cost penalty. Standard features include overvoltage protection and over current protection. This power supply offers a natural technological match for microcomputer systems. You can replace the 7-8 lb. boat anchor with a 14 oz. switcher and save 70% of the space and get 80% less heat as well. All this and a price that is dollar for dollar competitive with low cost linears. Price for 100 each quantity is \$99. Availability is 4 weeks ARO. For further information contact

Boschert Associates, 384 Santa Trinita, Sunnyvale, CA 94086, (408) 732-2440.

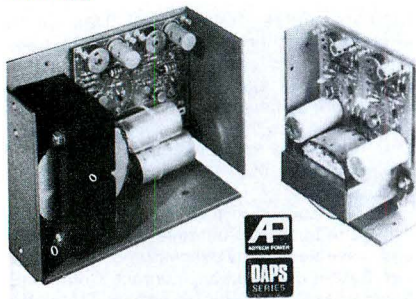
CIRCLE INQUIRY NO. 196

"DAPS"

Designated the "Gold Dust Twins" and "big Red" series, the units have gold and red irridite finished chassis respectively.

Designed for Universal applications, the entire line has primary A.C. Input capabilities to operate over a range of 115/230 V. ± 10%,

47-63Hz at a temperature up to 50°C ambient with *no derating* required for 47-63Hz operation that is normally the case with competitive units. (Units may be operated up to 65°C with derating.)



Highly reliable due to special design and conservative componentry, calculated MTBF using MIL-HDBK-217A guide lines is over 60,000 Hours. Warranty is 2 years.

DAPS Units are constructed on an open aluminum chassis with approximately 20% more heat sink area than most competitive power supplies. Mounting may be accomplished in various orientations with optional fasteners available.

Overvoltage protection is available with either one OVP on each output or a single one to protect both outputs.

Electrostatically shielded transformers provide lower high frequency noise experience. All units are regulated by hermetically sealed integrated circuit regulators in metal enclosures and all transistors used are hermetically sealed TO 3 can types.

All units may be connected in series or parallel to provide higher output voltages and currents.

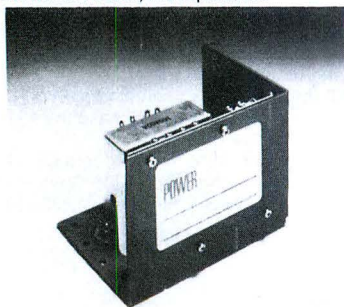
Regulation is $\pm 0.05\%$ for line; $\pm 0.1\%$ for load. Ripple is 2 mV RMS; (3 mV Peak to Peak maximum). Available in reasonable quantities off-the-shelf, the DAPS Series is normally shipped within 3 days after order.

Complete technical specifications on the "DAPS SERIES" and application assistance are available from: Adtech Power, Inc., 1621 S. Sinclair St., Anaheim, CA 92806. (714) 634-9211.

CIRCLE INQUIRY NO. 197

Unregulated DC Power Supply for Microprocessor-Based Systems

A DC power supply which provides unregulated power to microprocessors and peripheral equipment has just been announced by Standard Power, Incorporated.



The power supply, designated the SMP 30B, directly interfaces with the power requirements of microprocessors that have point-of-use voltage regulators on their printed circuit boards.

The unit provides three upstream voltages of 9 Vdc @ 1.0 amps and ± 18 Vdc @ 0.5 amps. It may be operated at 115V or 230V, 50 or 60 Hz input.

Priced at \$27.50 each (single quantity), the SMP 30B features simplicity of design and compact size. It measures 3 3/4" W x 3 3/4" H x 4 1/4" L, and weighs 2.1 pounds.

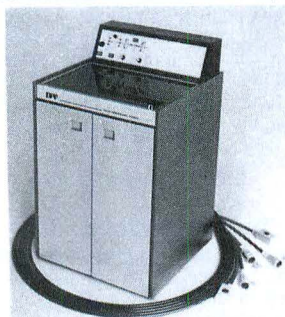
Complete details are contained in Standard's Catalog C477, available on request from local distributors or Standard Power, Incor-

porated, 1400 S. Village Way, Santa Ana, CA 92705.

CIRCLE INQUIRY NO. 198

Power Center . . . First to Receive UL Listing

The new system completely eliminates "hard-site," rigid conduit wiring installation and relocating costs, and reduces "antiquated" electrical contractor methods and expense.



CPC is compatible and interfaces with *all* major lines of computer main frame and peripheral equipment. The CPC is available in a wide range of standard KVA and input/output voltage ratings to accommodate computer installations of any size. Each CPC unit is engineered for the expansion of the EDP center it serves. Additional cable installation is easily accomplished in a matter of minutes.

The system is fully grounded throughout, interfaces with buildings' safety and emergency systems, and is approved by the Underwriter's Laboratories as a computer peripheral, in compliance with UL-478 for the data processing environment. The system meets the standards of the National Electrical Code (NEC) and has been tested and approved by the Los Angeles Department of Building and Safety.

A unique CPC feature is its Power-Flow Panel which shows at a glance the status of the power being supplied to the data processing system. Standard indicators and controls include phase-loss indicators, input voltmeter, thermal overload monitor, emergency power-off button, output voltmeter, system alarm, and other optional features.

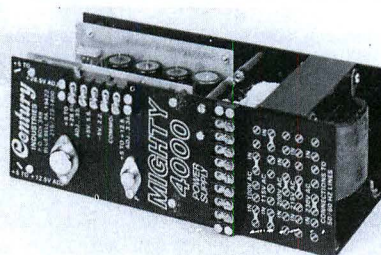
Easily installed, the CPC requires no special electrical contractor's services with the single exception of units junction box which is shipped in advance of the CPC. The Computer Power Center can typically be installed in less than two hours!

For complete information on the Computer Power Center, please contact Marketing Services, Data Processing Power Corp., 12638 Beatrice St., Los Angeles, CA 90066, (213) 390-8931.

CIRCLE INQUIRY NO. 199

DC Quad Power Supply Kit for Microprocessor Applications

Since the microprocessors are here in full force, single P.C. board mini computers are a reality. Century Industries introduces for the first time a professionally designed quad output power supply in kit form — the MIGHTY 4000K. The same supply is also available wired, fully tested and burned in, the model is called the 4000W.



The supply's electrical parameters were defined by computer system specialists and designed by power supply engineers who have mastered such an art. This supply is especially designed to completely handle the total power requirements for a CPU with up to 64K of RAM memory. This supply even includes an adjustable output for on-board programming of fusible-link PROMS. This neat and efficiently packaged power supply is an ideal companion for TI's TMS-9900, TMS-9980, Zilog's Z-80, Fairchild's F-8, Intel's 8080 or just about any other MPU on the market today or in the future. The supply features regulated and short circuit protected outputs of:

- +5V @ 5.5A fixed output
- +5V @ 1.9A to +12V @ 3.3A adjustable output
- 5V @ 2.2A fixed output
- +12V @ .23A to +28V @ .33A adjustable output

The above specifications are free air ratings up to +40°C ambient temperature.

Size of the supply is: 10.66 in. L. (27.07 cm) x 4.43 in. W. (11.25 cm) x 3.80 in. H. (9.65 cm), net weight 8.5 pounds (3.86 kilos), shipping weight 10 pounds (4.54 kilos). Operates on 115/220 50-60 Hz line voltage. The supply can be operated up to +71°C if the output load currents are derated 50%. Price of the Kit Model #4000K is \$99.00 each, prepaid, freight charges collect.

Other models and generous discounts are available for the large quantity buyers. Send for complete information and direct your orders to: Century Industries, P.O. Box 348, Blue Bell, PA 19422, (215) 272-1400.

CIRCLE INQUIRY NO. 200

New Power Modules Model No. DA50

Abbott's new DA50 series of high efficiency switching regulated power modules are designed specifically for computer and computer peripheral applications. Each unit is operable from user selectable inputs of 115 VAC $\pm 10\%$ single phase or three phase Wye, or 320 VAC $\pm 10\%$ single phase or three phase Delta. Three units are available with outputs of 5 VDC, ± 12 VDC and ± 15 VDC with total power of 50 watts. Full power is available at ambient temperatures of 55°C with 50% derating at 71°C.



Line and load regulation is less than 0.5% and peak-to-peak ripple is less than 100 mV. Standard features include overvoltage protection, short circuit protection, overtemperature shut-down and remote error sensing. Measured efficiency is as high as 80%. All this performance is packaged in a low profile case only 5.5" x 9.4" x 2.0".

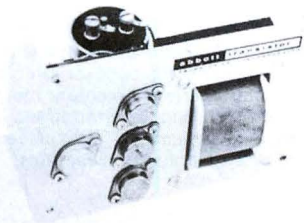
Other series in this new line include 100 and 200 watt output plus 41 to 52 VDC input models at 50, 100 and 150 watts output.

Price is \$310.00 (for unit quantities), delivery stock to ten weeks. Send for Abbott's 1976-77 Power Supply Catalog for complete details on other lines of power modules. For further information contact Andrew Hilbert, Abbott Transistor Laboratories, Inc., 5200 W. Jefferson Blvd., Los Angeles, CA 90016, (213) 936-8185.

CIRCLE INQUIRY NO. 201

New Power Module Case Size BB, Dual Output

The "BB" series of the new NL line provides dual outputs of $\pm 12\text{V}/1.7\text{A}$ or $\pm 15\text{V}/1.5\text{A}$ in a single unit. Standard input is 115 VAC, 47 to 440 Hz with 220 VAC available at no additional cost. Dual primaries are also available. All units feature tight regulation, low ripple and full load operation at 50°C ambient temperature with derating to 40% at 71°C.



Overvoltage protection is available as an optional feature. Case size is only 7 x 4 1/4 x 2 1/2 inches with mounting on three surfaces. High

quality components are used throughout with conservative design margins to assure high reliability and long life under worst case operating conditions. \$75.00 (1-24 pieces), normally delivered from stock.

The NL line also includes single, dual and triple output models with power ratings from 15 to 170 watts. Send for Abbott's new 1976-77 Industrial Power Supply Catalog for complete details on this and other lines of power modules. Abbott Industrial Products Division, 639 South Glenwood Place, Burbank, California 91506, (213) 841-2510.

CIRCLE INQUIRY NO. 202

New Power Module Model No. DA100

Abbott's new DA100 series of high efficiency switching regulated power modules are designed specifically for computer and computer peripheral applications. Each unit is operable from user selectable inputs of 115 VAC $\pm 10\%$ single phase or three phase Wye, or 230 VAC $\pm 10\%$ single phase or three phase Delta. Three units are available with outputs of 5 VDC, ± 12 VDC and ± 15 VDC with total power of 100 watts. Full power is available at ambient temperatures of 55°C with 50% derating at 71°C.



Line and load regulation is less than 0.5% and peak-to-peak ripple is less than 100 mV. Standard features include overvoltage protection, short circuit protection, overtemperature shut-down and remote error sensing. Measured efficiency is as high as 80%. All this performance is packaged in a low profile case only 5.5" x 10.5" x 2.5".

Other series in this new line include 50 and 200 watt output units plus 41 to 52 VDC input models at 50, 100 and 150 watts output.

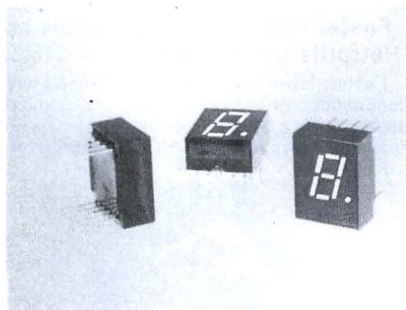
For further information contact Abbott Transistor Laboratories, Inc., 5200 W. Jefferson Blvd., Los Angeles, CA 90016, (213) 936-8185.

CIRCLE INQUIRY NO. 203

Components

.5" High LED Displays from IEE

Industrial Electronic Engineers, Inc., (IEE), California based supplier of diversified, information display systems, digital readout devices and connectors, is now offering .5" high, LED displays designated as IEE-HERCULES 1786 through 1789.



Series 1786 through 1789 of .5" (12.70mm) high, deep red characters, 0-9 with right hand decimal and ± 1 . These LEDs are available in common cathode or common anode configurations with typical 600 $\mu\text{cd}/\text{segment}$ luminous intensity at 20mA/1.7V.

GaAsP emitting material provides for maximum current-to-brightness efficiency with high contrast ratio. Slimline construction and single plane allow for wide angle viewing. There are ten horizontal in-line pin connections on .1" spacing, adaptable to either strip socket or PC board mounting. These new LEDs are interchangeable with Fairchild Models FND500 and FND507.

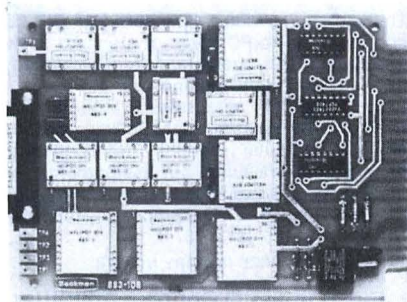
In 500 piece quantities, Models 1786 through 1789 are \$1.15 each. Delivery is off-the-shelf. A Product Profile featuring dimensional drawings, pin assignments, and electrical characteristics is available free upon request to: IEE, 7740 Lemona Avenue, Van Nuys, CA 91405, (213) 787-0311, ext. 268, attn: Bob Brandt, Product Sales Manager.

CIRCLE INQUIRY NO. 204

Telephone Tone Receiver Filter Modules

Series 883 hybrid tone receiver products are available as individual modules and assembled on a completely pretested, ready-to-use card. The series includes a dial tone reject filter

(883-1), low-band filter (883-2), high-band filter (883-3), dual limiter (883-4), eight band-pass filters (883-6 to 16), and a quad tone detector (883-5).



Two additional products, Models 883-107 and 883-108, are available as a set of Series 883 hybrids together with other associated electronic components mounted on a P.C. card forming a complete tone decoder subsystem. This subsystem is a major portion of the electronics used in the modern telephone central office receiver to interpret numbers entered by a user at the telephone hand set keyboard.

By applying a limiter approach rather than an automatic gain control, Series 883 allows the tone receiver to decode tone burst repetition rates as high as 25 bursts/second without degrading key performance parameters.

The hybrids meet Bell System requirements for application in its central office equipment manufactured by Western Electric. They also satisfy the requirements of other major and independent manufacturers of telephone equipment in supporting their respective operating companies (e.g., GTE Automatic Electric).

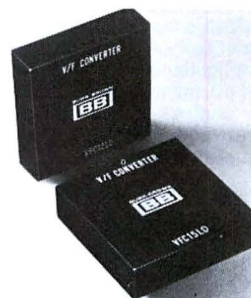
For additional information on the Series 883 hybrid tone receivers, contact Beckman Instruments, Inc., Technical Information Section, Helipot Division, 2500 Harbor Blvd., Fullerton, CA 92634.

CIRCLE INQUIRY NO. 205

Low-Drift V/F Converters Offer Best Price/Performance Tradeoff

Burr-Brown's new VFC12LD and VFC15LD offer designers low-drift specifications exceeded only by converters that cost twice as much. Drift, guaranteed by Burr-Brown to be

less than 10ppm/°C for both units, it typically less than 8 ppm. Linearity, spec's at better than $\pm 0.005\%$ for both the VFC12LD and VFC15LD, is far better than most VFC's in general use today.



The increased importance of V/F converters as a low-cost technique for analog-to-digital conversion, indicates that the VFC12LD, with its 0 to 10V input range and DC to 19kHz output frequency, and the VFC15LD with 0 to 20V or 0 to 20mA analog input and DC to 20kHz output, will find many new applications where digital resolution of 12 or 13 bits is required.

Both of the new units are of modular design measuring 1.5" x 1.5" x 0.4", are completely self-contained and require only $\pm 15\text{Vdc}$ power. Gain and offset can be adjusted with external potentiometers. Both are available from stock.

U.S. prices for the VFC12LD are \$57 ea. (small quantities) and \$46 ea. (100-up). The VFC15LD is priced at \$59 ea. (small quantities) and \$47 ea. (100-up).

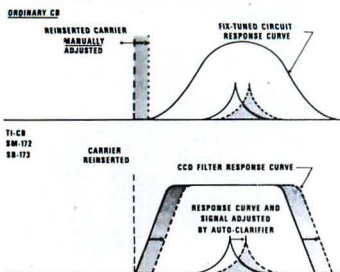
For more information, contact Joe Santen, Product Manager, Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 206

CCD Filter Locks-in Radio Signal

A charge coupled device (CCD) filter, a spin-off from advanced airborne radar technology, works with a tiny computer in the new Texas Instruments CB radio to automatically track, refine and lock-in the proper radio signal for superior voice quality. This is the first time a CCD filter has been used in citizens band radio.

COMPARISON OF SSB CLARIFIER CAPABILITIES



CCD is a sophisticated semiconductor technology developed by TI for imaging and signal processing and memory applications. It is used to enhance signal-to-noise ratio for optimum target detection and as a simplified structure to significantly increase memory cell density.

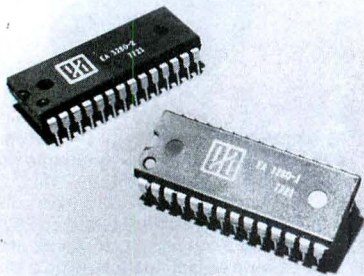
As the final filter in TI's unique triple conversion receiver, the CCD tunable filter provides variable bandwidth and variable frequency capabilities in one device for optimum performance. The microcomputer in the transceiver automatically fine tunes the CCD filter to the frequency of income TI SSB signals. With its "sharp" response curve, the CCD filter provides over 80 decibels of adjacent channel rejection compared to a 45 decibel standard for conventional CBs.

For further information, contact Texas Instruments Incorporated, P.O. Box 5012, Dallas, TX 75222.

CIRCLE INQUIRY NO. 207

EA3280 BASIC — First Firmware ROM

The EA3280 is the first firmware based ROM. It is a set of two EA3200 ROMs (4K words X 8 bits each) containing 6K basic with floating point, TTY I/O, memory check, ODT-80 monitor, and other routines. It is a high-level, easy-to-use language for use in an 8080 microprocessor system.



The basic has been in use for two years. However, it has only recently become available due to the advent of Electronic Array's 32K ROM.

The EA3280 LLL Basic Interpreter chip set is available with an assembly listing and user's manual for \$95.00 in quantities of 1-24. The 100-piece price is \$70.00.

For further information, contact Electronic Arrays, Inc., 550 E. Middlefield Road, Mountain View, CA 94043, (415) 964-4321.

CIRCLE INQUIRY NO. 208
Assist to Users

The memory technical staff of NEC Microcomputers in Lexington, Mass. will assist users and prospects in identifying the required parameters for designing memory boards using NEC's system. Turnaround time for a test board will depend on accurate definition of the board to be built for the prospective user, the firm said.

NEC Microcomputers Inc. markets LSI memories, the iCOM-8 family of 8080A microprocessors and microprocessor support chips throughout North America through a network

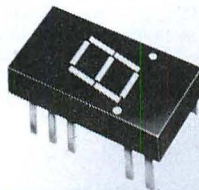
of sales representatives and distributors in all market areas.

NEC's line of fluorescent displays, TTL 7400 devices, audio IC's for the citizens-band radio market, and TV integrated circuits, are marketed in North America by NEC America's Electron Devices Division based in Santa Clara, CA. For further information, contact, NEC Microcomputers Inc., 5 Militia Dr., Lexington, MA 02173, (617) 862-6410.

CIRCLE INQUIRY NO. 209

.3" High LED Displays from IEE

Industrial Electronic Engineers, Inc. (IEE), California based supplier of diversified, information display systems, digital readout devices and connectors, is now offering .3" high, LED displays designated as IEE-HERCULES Model[®] 1737 through 1739.



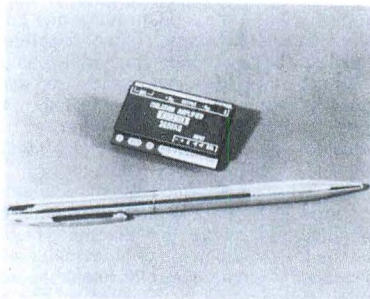
Model 1737 is common anode with right and left hand decimal; Model 1738 is common cathode with right hand decimal, and Model 1739 is common anode with ± 1 overflow indicator. All of these LEDs have excellent red character appearance and uniform segments with high contrast and wide viewing angle. These displays feature standard 0.3" DIP LED configuration to PC board or standard socket mountings. They are categorized for luminous intensity and are IC compatible.

In 500-piece quantities, Models 1737 through 1739 are \$1.20 each. Delivery is off-the-shelf. A detailed Product Profile featuring dimensional drawings, pin assignments, and electrical characteristics is available free upon request to: IEE, 7740 Lemona Avenue, Van Nuys, CA 91405, (213) 787-0311.

CIRCLE INQUIRY NO. 210

First Optically Coupled Amplifier to Provide 0.05% Accuracy

Designers who have shied away from optical coupling in isolation amplifiers because of gain nonlinearity specs can now take another look.



365KG, an addition to the optically-coupled line, has a typical gain nonlinearity spec of $\pm 0.02\%$ and maximum of $\pm 0.05\%$. This brings the advantages of optical coupling within the reach of industrial and process control, and nuclear reactor instrumentation applications.

Gain stability of the new unit is held to $\pm 0.005\%/^{\circ}\text{C}$; input offset voltage is ± 0.5 mV max; and input offset voltage drift is ± 5 $\mu\text{V}/^{\circ}\text{C}$ max. Other key parameters, which now apply to earlier versions of the 3650 and 3652 as well, include: Isolation voltage of 2,000V minimum; DC isolation mode rejection of 140 dB; leakage current (240V @ 60 Hz) of 0.25 μA

max; and bandwidth (± 3 dB) of 15 kHz.

Packaged in a ceramic housing measuring 1.75" x 0.9" x 0.22", the 3650KG has a specification temperature range of 0°C to $+85^{\circ}\text{C}$. Power supply requirements are $\pm 8\text{V}$ to $\pm 18\text{V}$ for both input and output stages.

The 3650KG is priced at \$69.00 (1-24), \$56.00 (25-99) and \$47.50 (100-999). Delivery is from stock.

For more information, contact Naresh Shah, Product Manager, Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 211

Power Line Filter

The Power Line Interference Filter is designed for use where microprocessor teletype, TV games or other interference enters the power line. This 350 watt unit, inserted in the line at the offending equipment, will prevent interference propagation via power lines.

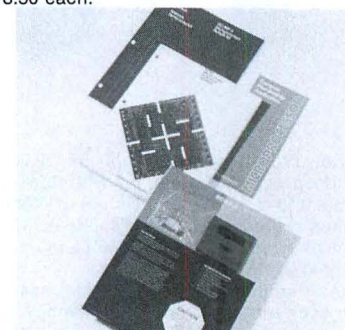


Also useful in cases where TV, FM or other listener equipment picks up interference from the AC lines. \$10.50, 2 conductor. \$13.50, 3 conductor. For more information contact Electronic Specialists, Inc., Box 122, Natick, Mass. 01760.

CIRCLE INQUIRY NO. 212

Faster N/MOS CPUs Available as Retrofits on SC/MP Kits for \$18.50

Faster, lower power, n-channel metal oxide semiconductor versions of National Semiconductor Corp.'s SC/MP microprocessor are now available as retrofits on SC/MP kits for only \$18.50 each.



Called the SC/MP-II, the new 8 bit single chip device has all the features of the original p-channel MOS version but will operate at twice the speed and will dissipate less than 200 milliwatts of power, about 25 percent that of the first SC/MPs introduced by National Semiconductor Corp. about one year ago.

SC/MP-II requires only a +5 volt supply, a key to the substantial reduction in power dissipation and the lower power supply cost, since the +5 and -7 volt supplies required on earlier versions have been eliminated. And because of the +5 volt only operation, the SC/MP-II can be easily interfaced with TTL and N/MOS devices, and, by using pull ups, with CMOS devices.

To aid users of present SC/MP Kits in evaluating the new SC/MP-II, the SC/MP-II Microprocessor Retrofit Kit is being made available for the \$18.50. It includes the new SC/MP-II CPU, a 2MHz crystal, a retrofit kit users' manual, an applications handbook and a SC/MP-II data sheet.

Like its predecessor, the SC/MP-II combines 8 bit data handling with 16 bit addressing and has serial input/output ports for interfacing. It also provides an on-chip clock, built-in flags, and jump conditions and three bus-access signals as well as an interrupt structure that responds quickly to asynchronous events. A delay instruction simplifies timer operations and there are 46 control oriented instructions.

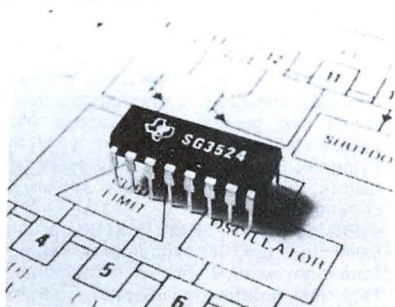
The SC/MP-II is completely pin compatible with the original SC/MP except for minor modifications to the crystal frequencies. Both are object code compatible, which allows the user to take advantage of SC/MP-II features (except for the higher speed operation) as soon as the retrofit procedures have been completed. No software changes are required, so long as the retrofitted SC/MP-II runs at the same speed as its predecessor. And once modified to use the SC/MP-II chip, both the SC/MP Kit and the SC/MP INTROKIT can be interfaced with the SC/MP Keyboard Kit.

For further information contact National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051, (408) 737-5000.

CIRCLE INQUIRY NO. 213

Bipolar Microcomputer Chip Set

A high-performance bipolar, microcomputer chip set has been announced by Texas Instruments Incorporated.



The S481 chip set is a new series of Schottky TTL microprogrammable building blocks offering up to 10 times the throughput rates of conventional microprocessors. Available in both commercial and military temperature ranges, the S481 chip offers a high degree of flexibility which enables users to tailor their system designs to applications. Intended for use in mini and midi computers, fast controllers, super processors, etc., the S481 Chip Set offers the following features:

- **High Speed** — up to ten times faster than conventional microprocessors. The S481 chip set can select and operate on two operands, generate status, and store results in a single 100 nanosecond microcycle.
- **Software Community** — complete microprogrammability for emulating existing instruction sets.
- **Memory Efficiency** — instructions can be tailored to specific applications to use memory more efficiently, reduce hardware costs.
- **Flexibility** — the S481 chip set hardware can be tailored to meet a wide variety of military and commercial applications. Expansion and upgrading is simplified. The S481 chip set can be used to make a 4, 8, 12, 16, or any $N \times 4$ bit system as desired.

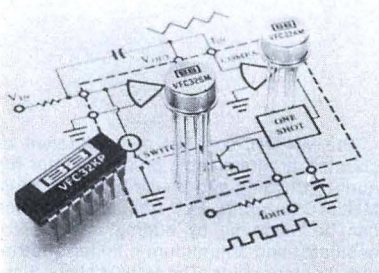
The S481 chip set consists of one or more SN54S/74S481 4-bit slice processors, one or more SN54S/74S482 4-bit slice controllers, an appropriate number of either the SN54S/74S330 or 331 field programmable logic arrays, and selections from a wide variety of Schottky PROMS and RAMS. A variety of high-density universal interface circuits are also available.

For further information, contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: S481), Dallas, Texas 75222.

CIRCLE INQUIRY NO. 214

Monolithic V/F Converter Offers Designers Sevenfold Improvement in Linearity

The first monolithic voltage-to-frequency converter to offer guaranteed $\pm 0.01\%$ (12-bit) linearity at 10 kHz and operation to 0.5 MHz is now available from Burr-Brown. The new unit, designated the VFC32, is priced significantly below similar monolithic converters that provide only $\pm 0.07\%$ (9-bit) linearity.



The VFC32 can be used as either a V/F or as an F/V converter and has a six decade dynamic range (0.5 Hz to 0.5 MHz). Most monolithic V/F converters have a dynamic range of only 100:1. Linearity at the top frequency is $\pm 0.2\%$ (8-bit) and at 100 kHz it is $\pm 0.05\%$ (10-bit).

The VFC32 accepts voltage inputs of 0 to +10V or 0 to -10V and current inputs up to 0.25 mA positive. The output is an open collector, thus the unit is compatible with DDT, TTL and CMOS logic.

An external RC network sets up the full-scale frequency, and one additional pull-up resistor and one-shot capacitor are also required for operation. Temperature coefficient of the full-scale accuracy is ± 100 ppm/ $^{\circ}\text{C}$ max. and the input offset voltage drift is less than ± 2 ppm/ $^{\circ}\text{C}$.

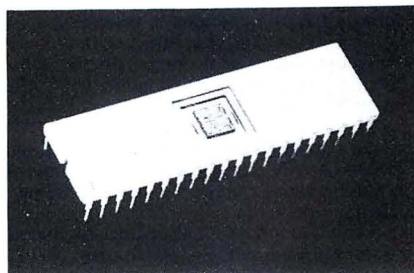
The VFC32 is available in three models and two package configurations. The lowest cost version (VFC32KP) is a 14-pin epoxy DIP specified from 0 to $+70^{\circ}\text{C}$. The BM and SM versions are contained in a hermetically sealed TO-100 package and are specified over the ranges of -25 to $+85^{\circ}\text{C}$ and -55 to $+125^{\circ}\text{C}$ respectively. All units are fully tested over their entire temperature ranges and all have identical room temperature specs.

Prices are as follows: VFC32KP, \$10.20 (1-9), \$8.10 (25-99), and \$6.10 (100-249). VFC32BM, \$13.90 (1-9), \$10.10 (25-99), and \$8.00 (100-249). VFC32SM, \$19.00 (1-9), \$14.40 (25-99), and \$11.70 (100-249). For more information, contact Joe Santen, Product Manager, Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 215

Multi-Protocol Communications Controller

A programmable LSI chip that formats, receives and transmits serial digital data in Synchronous Data Link Control (SDLC) and all other synchronous data communications protocols is now available from Signetics.



Called the Signetics 2652 Multi-Protocol Communications Controller (MPCC), the unit operates at data rates up to 500,000 bits per second from a single +5V power supply and supports bit-oriented protocols such as SDLC, HDLC and ADCCP and byte-oriented protocols such as BISYNC and DDCMP. The unit employs double ion-implanted, N-channel MOS technology and is fully compatible with TTL circuits.

Both receiver and transmitter sections are double buffered and operate in either half or full duplex modes. The chip can be interfaced with an 8 or 16-bit data bus, thus making it compatible with most mini and microcomputer systems.

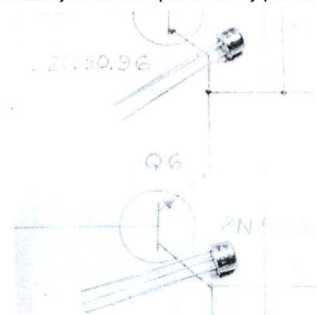
Sample quantities of the Multi-Protocol Communications Controller are available from Signetics, with full production quantities expected by mid-year. Price for the unit is under \$30 in quantities over 100.

For further information, contact MOS Microprocessor Marketing, Signetics, 811 East Arques Ave., Sunnyvale, CA 94086, (408) 739-7700, ext. 3376.

CIRCLE INQUIRY NO. 216

Complementary Power Transistors Exhibit 500V V_{CBO}

Two new series of triple-diffused epitaxial NPN and PNP power transistors, from Solid State Devices, Inc., has the large signal and medium power characteristics that make them ideal for industrial control applications either individually or as complementary pairs.



The four PNP devices, designated the 2N5091 series, have collector-base voltages from 350V to 500V with 100 μA collector current, collector-emitter voltages from 300V to 450V with collector currents of 50mA, and an emitter-base voltage of 6V. Collector-emitter saturation voltage is 3V with a 25mA collector current and a 2.5mA base current. Base-emitter voltage is 1V at 25mA collector current and 10V base-emitter voltage.

The six NPN devices, designated the 2N5092 series, exhibit collector-base voltages from 400V to 800V with a 100 μA collector current, collector-emitter voltages from 350V to 550V with a collector current of 50mA, and an emitter-base voltage of 6V. Base-emitter voltage is 1V with 25mA collector current and 5V collector-emitter voltage. Collector-emitter saturation voltages are 0.5V with a collector current of 25mA and a base current of 2.5mA.

Continuous power dissipation for both series are 2W at 100°C with a linear derating factor of 26.7mW/ $^{\circ}\text{C}$ above 100°C . Operating temperature is -55°C to $+175^{\circ}\text{C}$.

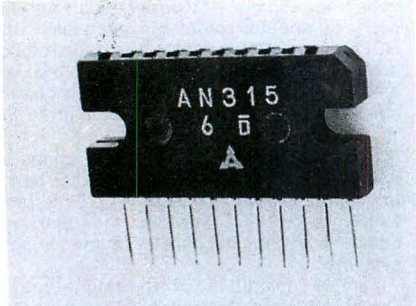
The PNP 2N5091 series are priced from \$22.00 each to \$16.00 each in quantities of 100. The NPN 2N5092 series are priced from \$15.00 each to \$11.00 each in 100 quantities. Delivery is stock to 30 days. For further information contact Solid State Devices, Inc., 14830 Valley View Avenue, La Mirada, California 90638; (213) 921-9660.

CIRCLE INQUIRY NO. 217

5.5 Watt Audio Power Amplifier

The AN315 is ideal for auto radios, auto stereos and tape recorders. The device consists of a differential pre amplifier, a drive

amplifier, a ripple filter, an automatic operating point stabilizer and a quasi-complementary SEPP OTC power amplifier circuit.



The AN315 features: high power (5 watt), high gain (53DB closed circuit), overload and short circuit protection, shock noise free, low noise, and unique easy handling 11 pin single in-line package with .1 in. pin spacing. Available from stock at:

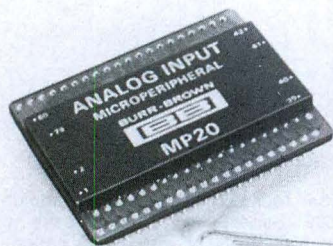
1-24	25 up	100 up
\$3.90	\$3.20	\$2.50

For further information contact Tom Nixon at: Energy Electronic Products Corporation, 6060 Manchester Ave., Los Angeles, CA 90045, (213) 670-7880.

CIRCLE INQUIRY NO. 218

Microprocessor-Compatible Analog Input Component

This hybrid, quad-in-line package consists of a 16-channel analog multiplexer, high-gain instrumentation amplifier, 8-bit A/D converter, plus all necessary address, data- and control-bus interfaces.



The MP20 is timing and logic level compatible with 8080A and 8008 type microprocessors. No external logic is needed. And gain and offset are internally laser-trimmed, eliminating the need for external adjustments while providing absolute accuracy better than $\pm 0.4\%$ (1 LSB) on the $\pm 5V$ or 0 to $+5V$ ranges.

To simplify programming and allow for unlimited channel expansion, the MP20 is treated as memory. Each analog input channel occupies one memory location. Any memory reference instruction can be used to access data. Thus one LDA instruction will input data from one channel to the accumulator. Two adjacent input channels can even be acquired with one LHL instruction. Alternately, the MP20 can be interfaced as I/O.

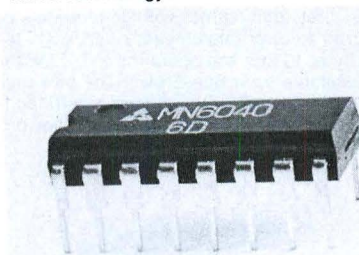
Housed in a $1.7'' \times 2.1'' \times 0.15''$ ceramic package, the MP20 is specified over a 0° to $+70^\circ C$ temperature range. Power requirements are $\pm 15VDC$ and $+5VDC$. Price of the MP20 is \$195 (1-9) and \$140 (100's). Delivery is from stock. For more information, contact C. R. Teeple, Product Manager, Burr-Brown, International Airport Park, Tucson, Arizona 85734. (602) 294-1431.

CIRCLE INQUIRY NO. 219

MN6040 CMOS Frequency Synthesizer

The device is a single chip phase-locked loop intended for use in CB transceivers and

other communications equipment. The MN6040 is fabricated by Silicon-Gate CMOS process with the maximum use of ION implantation technology.



The MN6040 consists of a reference signal counter, programmable preset counter for frequency dividing and phase detector. With the MN6040 an entire PLL frequency synthesizer can be made up by adding a VCO, crystal oscillator and a minimum number of other external components. The MN6040 is particularly suited for use in multi-channel transceivers.

Features: 10.24 MHz oscillation frequency, pure binary code used as the preset counter input, the maximum operating frequency of the programmable counter is 2.55 MHz, the phase detector output (PD) is open during lock, the lock-in detector output (LD) remains in the "H" level during lock and provides random output pulse when unlocked, all preset inputs have protection against static charge — a "Pull-L" resistor is provided on each terminal.

Available from stock at:

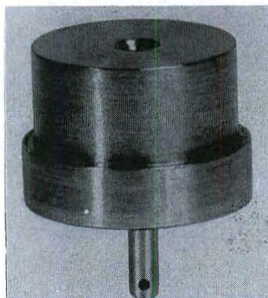
1-24	25-up	100-up
\$7.90	\$6.80	\$5.20

For further information contact, Energy Electronic Products Corporation, 6060 Manchester Ave., Los Angeles, CA 90045, (213) 670-7880.

CIRCLE INQUIRY NO. 220

TO-5 Impulse Solenoid

Artisan Electronics has announced a new miniature solenoid designed with body dimensions equivalent to that of the TO-5 transistor case.



Most applications for this TO-5 are for impulse duty—the generation of relatively high forces for short times or for pulsed operations on intermittent duty.

On such impulse duty, the average power should not exceed $\frac{3}{4}$ watt—instantaneous power may be as high as 200 watts, provided that the "on-time" does not exceed 25 milliseconds. At this duty, forces up to 50 grams may be generated at gaps of 0.100".

For applications of continuous duty the TO-5 solenoid will develop forces of from 1 to 10 grams with plunger travels up to .050". At this duty the solenoid is rated at $\frac{3}{4}$ watt.

A typical coil for operation on 12V DC impulses would have a resistance of 1.5 ohms, pulsed at 12V DC with a maximum on-time of 25 milliseconds and a minimum off-time 130 times the on-time.

For more information, contact Artisan Electronics, 5 Eastmans Rd., Parsippany, NJ 07054.

CIRCLE INQUIRY NO. 290

Digital Clock Displays Use Screened-on-Glass Planar Gas Discharge Technology

The Model SP421 planar, neon-gas-discharge 12/24 hour time display is the first standard product member of Beckman's SP400 line of Screened Image Displays. The SP421 is designed for use in clocks whose style demands large numerals and for applications requiring readability beyond 40 feet.



Characters include 4 one-inch digits, AM and PM annunciators, and colon. Attractiveness and readability are enhanced by display of its numerals against a stark, black background. Information conveyed by the brilliant, neon-orange glow of its one-inch digits is easily read, even in direct sunlight. A wide viewing angle of 130 degrees is provided by the SP421's flat planar design.

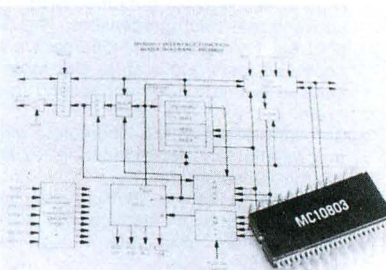
Features of the SP421, in addition to unusual character height, brightness, readability and general attractiveness, include: Easy installation by edgeboard connection or flying leads; AM and PM and colon annunciators; 12- or 24-hour operation; and low power consumption.

Pricing for the SP421 is \$1.66 per digit, in 5,000 digit (1250 units) quantities. For more information, write: Beckman Instruments, Inc., Technical Information Section, Information Displays Operations, P.O. Box 3579, Scottsdale, Arizona 85257, (602) 947-8371.

CIRCLE INQUIRY NO. 222

A MECL LSI Interface Device for High Speed Processor Systems

The MC10803 Memory Interface Function provides an interface between a high-speed processor subsystem, such as the MC10800 4-Bit ALU Slices, and system main memory or peripheral equipment.



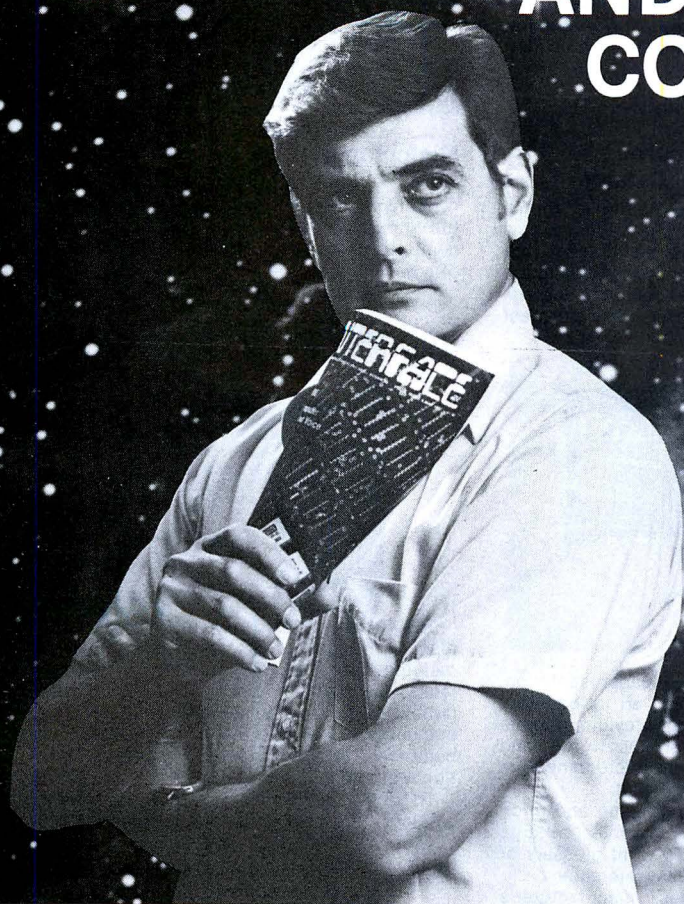
The MC10803 contains its own ALU: by providing arithmetic capabilities at an I/O address output port, the main processor can be unburdened of numerous tasks, thereby implying new dimensions to LSI system designs.

In an M10800 system, or many larger systems, MC10803s would be connected in parallel to provide multiple I/O ports, greatly relieving the overhead burden of the CPU.

The MC10803, as with all current M10800 family devices, is directly compatible with all the devices in the MECL 10,000 series. The MC10803 is housed in a 48-pin Quad-In-Line (QUIL) package. \$40.00 in 100-up quantities. For further information, contact: Motorola Semiconductor Products, P.O. Box 20912, Phoenix, Arizona 85036.

CIRCLE INQUIRY NO. 286

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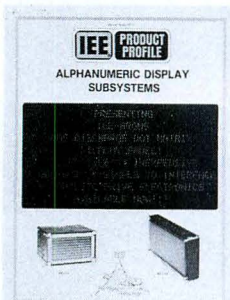
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Literature

Alphanumeric Display Subsystems Catalog Available from IEE

Industrial Electronic Engineers, Inc. (IEE), a world leader in information display systems, digital readouts, display components and a full line of connectors, is proud to introduce their new IEE-ARGUS Alphanumeric Display Subsystems Product Profile designated as AG-3.



This 20-page, 3-color brochure details how IEE's Alphanumeric Display Subsystems utilize a gas discharge dot matrix message panel to provide a display of characters in a 5x7 dot matrix format with underline and cursor capability. There are 14 subsystems ranging from 32 to 256 characters available in neon-orange or green. Synchronous, asynchronous and address-location loading modes make the system extremely versatile and simple to interface.

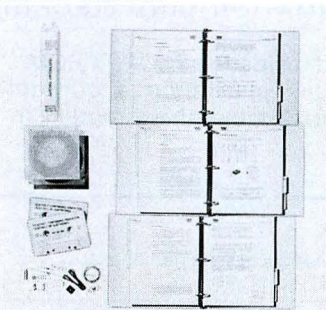
ASCII-coded English fonts are standard for every system's 64 character repertoire with optional foreign language fonts available. Also featured in AG-3 are optical, electrical, physical and environmental characteristics, power requirements, filter information, input connectors, character fonts, installation drawings and ordering information.

IEE-ARGUS Alphanumeric Display Subsystems Catalog is available FREE upon request to IEE, 7740 Lemona Avenue, Van Nuys, CA 91405, (213) 787-0311, ext. 275, attn. Bob Groshong.

CIRCLE INQUIRY NO. 223

Circuits Course

A learn-at-home electronics course covering the basic electronic circuits is one of four basic electronics courses which use programmed instructions plus audio records. The course comes complete with electronic parts for "hands on" experiments. Other courses in the basic electronics series include AC Electronics, DC Electronics, and Semiconductor Devices. An advanced course in Digital Techniques is also available.



Course EE-3104 covers basic and operational amplifiers, power supplies, oscillators, pulse circuits, modulation and demodulation with emphasis on integrated circuits. An optional final exam can be taken for Continuing Education Units (CEU's), a nationally recognized means of acknowledging participation in non-credit adult education.

Courses are mail-order priced at \$39.95. For further information, write for a FREE catalog to: Heath Company, Dept. 350-18, Benton Harbor, Michigan 49022.

CIRCLE INQUIRY NO. 224

Comprehensive Microcomputer Catalog

Byte Shops of Arizona are proud to announce the BYTE SHOPPER, a unique new 40-page catalog designed to present the fascinating world of personal computing to the public. The catalog features complete descriptions of microcomputer systems that can meet the needs of the hobbyist or businessman.



Recognizing the need for clear presentation, the BYTE SHOPPER is also an introductory text to personal computing, providing simple explanations of computer buzzwords and graphic visualizations of how microcomputers work and where they can be useful.

The BYTE SHOPPER is relaxing and informative reading with superb graphics on large (11" x 14") pages, and a 50 word glossary of commonly used terms for easy reference.

The catalog integrates manufacturer's specs with a down to earth discussion of how to use each product and how it relates to an overall computing system. Several typical systems are pictured and discussed in detail. Over 50 manufacturers are represented with pictures of nearly all products discussed, providing for the first time an effective access to the broad range of personal computers, peripherals, accessories and introductory texts. Most products are S-100 based and start from simple home systems all the way up to large timesharing multi-user systems. A price sheet has been included for the prospective buyer.

The BYTE SHOPPER is not just a catalog; it is a book designed to present the world of personal computing to virtually anyone. Lay it down on the dining room table, other members of the family will want to pick it up and read and understand it.

For further information, contact Byte Shop, P.O. Box 28106, Tempe, AZ 85282.

CIRCLE INQUIRY NO. 225

Dynascan Announces New B&K-Precision Test Instruments Catalog

The 44-page "BK-78" catalog features a broad range of cost-effective test instruments including oscilloscopes, frequency counters, digital and analog multimeters, audio and R-F signal generators, semiconductor testers, power supplies, and CB and TV test instruments. Also included is a very complete line of oscilloscope and instrument probes.

New products include three new frequency counters, ranging from a \$120 30MHz portable to a 520MHz counter with period measurement capability. Two new 3 1/2 digit portable digital multimeters and two new analog VOM's are also listed.

The entire line of instruments from B&K-PRECISION is locally stocked at distributors

nationwide. Most products are available for off-the-shelf delivery.

The catalog is available without charge from B&K-PRECISION, Dynascan Corporation, 6460 West Cortland Ave., Chicago IL 60635, (312) 889-8870.

CIRCLE INQUIRY NO. 226

Minicomputer Accessories Expands 1977 Catalog

Minicomputer Accessories, which offers a full line of accessories and supplies to minicomputer users, has announced the availability of a new enlarged catalog.



The 40-page catalog offers such products as disc cartridges, magnetic tape, floppy discs, carrying cases, binders, connectors, cables, racks, and cabinets for all makes of minicomputers; plus unique and hard-to-find items for end users as well as O.E.M.s. It also provides a number of suggestions for improving operational efficiency.

To obtain a free copy of the 1977 MCA catalog, write Minicomputer Accessories, 1015 Corporation Way, P.O. Box 10056, Palo Alto, California 94303.

CIRCLE INQUIRY NO. 227

Periodical Guide for Computerists

A new 20 page book indexes over 1,000 personal computing articles from 15 magazines for January-December 1976. The articles are indexed under more than 100 subject categories. Indexed are magazine articles, letters from readers, book reviews and editorials from both hobbyist and professional publications.

The books are available from: E. Berg Publications, 1360 S.W. 199th Ct., Aloha, Oregon 97005 for \$2.50 each postpaid and also from local computer stores.

A forthcoming issue in July will index January-June 1977 articles.

CIRCLE INQUIRY NO. 228

"... The Top Information Executive"

Something dramatic is in the early stages of its development — something that can affect all data processing management. This "something" is the emergence of a new management position that is being called "the top information executive."

EDP ANALYZER has a current series of reports that deals with aspects of this new management position.

The scope of this new function may be very broad. Potentially, it covers all information handling activities within the organization. These include data processing, data entry and collection, all forms of telecommunications, word processing and secretarial services, electronic funds transfer, clerical services, process control, printing and reproduction, and so on.

The goal is to tie these information handling activities together, to significantly enhance performance and to reduce costs.

For further information contact EDP Analyzer, 925 Anza Ave., Vista, CA 92083.

CIRCLE INQUIRY NO. 229

Free Catalog

Continental Specialties Corporation, manufacturers of breadboarding and test equipment for the professional and hobbyist, announces the release of their new 1977 catalog.

This 16-page catalog features the complete line of Continental Specialties' QT Stockets, Proto-Clips, Proto-Boards, Logic Probes, Logic Monitors and Design Mates and introduces the new Experimenter Sockets. (Experimenter 600 features .06" centers making it ideal for microprocessors' clock chips, RAM's, ROM's, PROM's, etc.; Experimenter 300 with .03" centers is perfect for small DIP's). Also featured are the new PC-40 Proto-Clips with or without cables.

All products shown in the catalog are in stock and available through CSC's distributors throughout the USA.

Catalogs are available from: Continental Specialties Corporation, 44 Kendall Street, P.O. Box 1942, New Haven, CT 06509.

CIRCLE INQUIRY NO. 230

Underground Buying Guide

A new directory has just been published that helps amateurs, CBers, experimenters and computer hobbyists locate equipment, parts, supplies and services.



Over 600 sources of standard and hard-to-find gear are listed in the handy guide. Many of the 600 sources are mail order firms and discounters. All are firms that do business with electronic hobbyists.

The guide easily pays for itself by the savings you make in buying from the least expensive source. In addition, you'll save countless hours of shopping and hunting for hard-to-find items. You won't have to worry about making a poor buying decision — you can easily review all products from the convenience of your living room chair.

The Underground Buying Guide is available by direct mail from PMS Publishing, 12625 Lido Way, Saratoga, CA 95070. The price is \$5.95 plus 55¢ postage and handling. Californians add 39¢ sales tax. Moneyback guarantee within 10 days if you are not completely satisfied.

For further information contact Dennis A. King, PMS Publishing, 12625 Lido Way, Saratoga, CA 95070, (408) 996-0471.

CIRCLE INQUIRY NO. 231

New Book of Programs in BASIC

Adam Osborne & Associates are the publishers of the best known and most used microprocessor books available, selling 10,000 to 15,000 books per month, with more than 300 university text adoptions. **SOME COMMON BASIC PROGRAMS** is the first of our new series of books of programs in BASIC. Consisting of 76 general purpose programs, **SOME COMMON BASIC PROGRAMS** is designed for anyone who has need of a variety of readily usable practical programs in BASIC. These programs cover financial, mathematical,

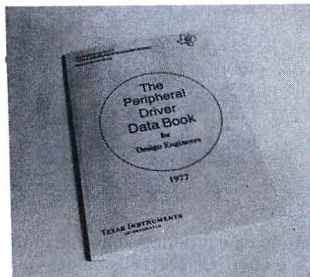
statistical, and general interest tasks and are written in a restricted subset of standard BASIC compatible with many of the versions of BASIC now available to microcomputer users. Every program has been tested and examples are published together with the source listings. Changes that you may wish to make to the programs are also described. PRICE \$7.50.

For further information, contact Osborne & Associates, P.O. Box 2036, Berkeley, CA 94702, (415) 548-2805.

CIRCLE INQUIRY NO. 232

Peripheral Driver IC Catalog Available from T.I.

A peripheral driver IC catalog is available from Texas Instruments Incorporated. Called "The Peripheral Driver Data Book for Design Engineers," the 120-page softback book provides comprehensive information on 46 peripheral driver ICs.



Featured are function tables, schematics, pin configurations and parametric measurement information. Also included are a product selection guide, application notes and interchangeability guide. Thermal and mechanical information is also provided on TI's ceramic and plastic dual-in-line packages.

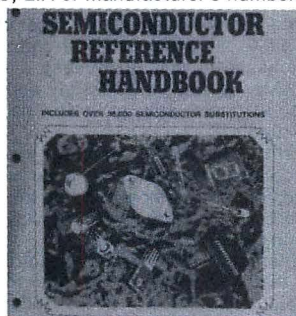
An added feature is a comprehensive selection guide for all Texas Instruments interface products, including line drivers, line receivers, transceivers, sense amplifiers, and display, memory and MOS drivers.

For further information, contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: LCC 4280), Dallas, Texas 75222.

CIRCLE INQUIRY NO. 233

New Semiconductor Reference Handbook

The Handbook is a compilation of data on Radio Shack's line of prime-quality Archer brand semiconductors. According to Radio Shack, every Archer device covered in this handbook is guaranteed prime—not "fall-outs" or "seconds" — all are top-quality, with known JEDEC, EIA or manufacturer's numbers.



A cross-reference listing is included in the handbook for replacement of transistors, diodes and other interchangeable devices. The total number of cross-referenced devices exceeds 36,000. These cross-reference/replacement listings are computer-selected and are based on careful analysis of the important parameters of the listed devices.

The handbook also has sections on the care and handling of transistors, soldering precautions, case styles and dimensions, how to

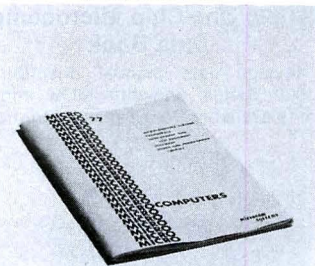
test transistors, and a glossary of words, symbols and abbreviations.

The Archer Semiconductor Reference Handbook is available exclusively from Radio Shack stores and dealers. The 128 page handbook is priced at \$1.95.

CIRCLE INQUIRY NO. 234

New Microcomputer Catalog

The new Micro 77 Computer Catalog from Microcom Systems describes numerous microcomputer and related products from dozens of well-known manufacturers. The catalog offers everything from simple low-cost kits to advanced systems designed for business, scientific, and engineering applications.



Catalog contents include sections on Microcomputers, Peripherals, Memory and I/O Boards, Development and Test Equipment, Software, Books and Computer Courses. New Products are introduced through frequent new product catalog updates to insure the reader has access to the latest in microcomputer advances.

For further information contact Microcom Systems, 865 3rd Street South, St. Petersburg, Florida 33701.

CIRCLE INQUIRY NO. 235

Latest Hobbyist Catalog

Continental Specialties Corporation, manufacturers of breadboarding and test equipment, announces that their Spring Catalog is now available for hobbyists and engineers.

This 24-page catalog features the complete line of Continental Specialties' products including the new EXPERIMENTOR Sockets. (Experimenter 600 features .06" centers making it ideal for microprocessors' clock chips, RAMs, ROMs, PROMs, etc.; Experimenter 300 with .03" centers is perfect for small DIPs.) Both are excellent additions to the hobbyist's or the engineer's breadboarding equipment.

In addition, CSC's latest catalog now makes it easier than ever to convert designs to hardware by providing three pages of electronic components including: integrated circuits, low power Schottky and CMOS; LEDs, trim pots, seven segment displays, diodes, transformers, and more . . . all available from CSC — all in stock and all backed by CSC's reputation for fast and efficient service.

Catalogs are available from Continental Specialties Corporation, 44 Kendall Street, P.O. Box 1942, New Haven, Conn. 06509.

CIRCLE INQUIRY NO. 236

Free Do-It-Yourself Microcomputer Recipe Book

A New MICROCOMPUTER RECIPE BOOK covers everything from soup to nuts, to put together your own microcomputer operating system for personal, business, or scientific use. Under *Ingredients*, there are a wide variety of system components such as computers, semiconductor and floppy disc memories, CRT displays, and hard copy printers. Suggested *menus* for complete systems range from the "BIG MAC," a simple 8080-based computer hooked into the family TV set, to the "BEEF

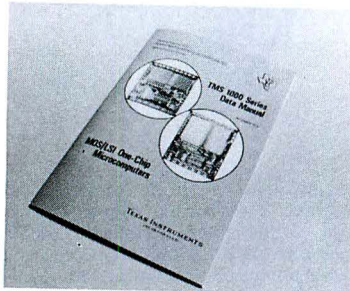
WELLINGTON" which includes a Processor Tech SOL 20 microcomputer, a dual floppy disc memory, and a DECwriter II printer as well as a video monitor. Whatever your gourmet taste demands, you will find it here . . . Bon Appetit!

In addition to the extensive menu of computer systems, the same recipe book includes a large selection of technical books relating to computer hardware design, software development, and "How to do it" books. For additional information contact J. Benbow Bullock, Vice President, Computer Center, Inc., 321 Pacific Ave., San Francisco, CA 94111, (415) 421-8686.

CIRCLE INQUIRY NO. 237

TMS1000 One-Chip Microcomputer Data Book

A 44-page data manual describing the TMS1000 Series one-chip MOS microcomputer is available from Texas Instruments.



The booklet describes the P-channel MOS 4-bit microcomputer that includes a ROM, a RAM and an arithmetic logic unit on a single semiconductor chip. Typical applications and product data are covered for the various versions of the TMS1000 family. This includes versions with a 2048 by 8-bit ROM and a 128 by 4-bit RAM built-in and versions for directly driving high-voltage displays.

Included also are data on design support for the TMS series available from TI which includes software assemblers and simulators; hardware simulators and debug controls and information on TI's system evaluator devices for prototype fabrication.

For further information, contact Texas Instruments Incorporated, Inquiry Fulfillment, P.O. Box 1443, M/S 653 (Attn: TMS1000 Data Book), Houston, Texas 77001.

CIRCLE INQUIRY NO. 238

The Small Computer Catalog Offered

A fully illustrated, 22-page color catalog describing the complete line of Processor Technology Corporation computers, computer systems, peripheral equipment and software is now available.

Applications as well as equipment are discussed. A centerfold chart reveals the computer applied in the home, for education, as a laboratory monitor and as a legal aid.

Following the introduction, the catalog discusses systems, personality modules, software, memories, disk storage, interfaces and peripherals.

For a copy, please address Processor Technology Corporation, 6200 Hollis Street, Emeryville, CA 94608, (415) 652-8080.

CIRCLE INQUIRY NO. 239

6800 Programming for Logic Design

Osborne & Associates announces a completely new book on a totally new subject: implementing digital and combinatorial logic using assembly language (in this case, within a 6800 microcomputer system). Traditional assembly language concepts are neither useful nor relevant to microprocessors used in digital logic applications. Using assembly

language instructions to simulate digital packages is equally wrong. These concepts are clarified by first solving problems in an incorrect — but understandable — way, then relating correct microcomputer use to this easily understood introduction. PRICE \$7.50.

For more information, contact Osborne & Associates, P.O. Box 2036, Berkeley, CA 94702, (415) 548-2805.

CIRCLE INQUIRY NO. 240

New, Free Heathkit Catalog

The latest Heathkit Catalog lists nearly 400 electronic products in kit form.



Among new products featured in the catalog are a 3-band UHF/VHF scanner, a matching stereo tuner and amplifier, a five-function aircraft clock timer and a programmable home heating control which is said to save up to 10% on home heating bills.

The catalog also describes nearly 400 other electronic kits including automotive and marine accessories, amateur radio equipment, test instruments, learn-at-home electronics courses, stereo equipment and color TV-s.

The catalog is available free from Heath Company, Dept. 350-13, Benton Harbor, Michigan 49022, (616) 982-3417.

CIRCLE INQUIRY NO. 241

S-100 Crate Design Information Package

The objective design crate information packet is a complete set of plans and specifications for building an S-100 compatible card file and power supply. The crate is of high quality, making use of standard, commercially available extrusions, card guides, and power supply components. The design is variable and can be adapted to any of the available S-100 motherboards.

The advantages of constructing a crate as opposed to buying one include: cost savings (the crate and power supply will cost approximately \$150, assuming all major components are purchased in unit quantities); a sturdier crate; easier to work with design; and opportunities to meet special crate needs by customizing.

For the commercial interest, the crate design can be the basis for in-house computer construction. For the hobbyist, the home constructed crate is a money-saving way to get started in personal computing.

To order the S-100 crate design information packet, mail a check or money order to Objective Design, Inc., P.O. Box 20456, Tallahassee, FL 32304. Cost is \$19.95 plus 4% sales tax for Florida residents. Postage prepaid on all items for U.S. delivery.

CIRCLE INQUIRY NO. 287

Periodical Guide for Computerists 1976

Useful catalog features indexing of computer-related articles in leading U.S. com-

puter magazines such as BYTE, Creative Computing, Digital Design, Dr. Dobb's, EDN, Electronic Design, Electronics, INTERFACE AGE, Microtek, P.P.G., Popular Electronics, SCSS-Int. and 73 Amateur Radio.

For prices and further information, contact E. Berg Publications, 1360 SW 199th Ct., Aloha, Oregon 97005.

CIRCLE INQUIRY NO. 243

Introduction to Microcomputers, Volume II — New Edition

Osborne & Associates announces its new and updated edition of INTRODUCTION TO MICROCOMPUTERS, Volume II — "Some Real Products". This book describes, in detail, all the microprocessor LSI devices available on the market. So current is this book that it describes devices which will be appearing months after its publication. Even more important, part descriptions are clear and unbiased. Moreover, all products are described in a consistent manner, allowing you to quickly compare one microprocessor with another. Not only are microprocessors described, but all support devices are covered. The new edition of "Some Real Products" will include complete descriptions of the new INTEL 8085 and 8048 microcomputers, and the first coverage available of the new Hewlett Packard 16-bit microprocessor chip. Volume II describes how to mix and match devices manufactured by various vendors. PRICE \$15.00 (available July 1, 1977).

Contact Osborne & Associates, P.O. Box 2036, Berkeley, CA 94702, (415) 548-2805.

CIRCLE INQUIRY NO. 244

Personal Computing Directory

The *Personal Computing Directory* will contain names, addresses, telephones, descriptive keywords, and other information about people, clubs, societies, associations, organizations, newspapers, magazines, manufacturers, equipment distributors, mail order services, kit vendors, software developers, maintenance and repair services, convention and meeting organizers, credit and non-credit courses, lectures, clinics, demonstrations, tours, contests, flea markets, in a word: everything related to the personal computing field! The directory will have three main parts. The first, a geographical, or zip code sorted listing, will consist of each name, address, telephone, and descriptors, listed in zip code order, and alphabetically within a zip code. Similar zip codes tend to be near each other, so you need only look for your own zip code to find people and organizations near you. The second part will be an alphabetically sorted list of people (last name first) and organizations. If you don't know the address, look up the name. The third part will be a subject listing, sorted alphabetically. Look up your subject and find people and organizations with similar interests.

This directory serves as a registry for people who would like to have a unique name for their system. It is analogous to call numbers used by radio amateurs. We would like to suggest something like the following: "Concertina 6800NH," where *Concertina* might indicate a music system based on the Motorola 6800 chip, and *NH* indicates it is located in New Hampshire. We will assist in the resolution of same-name conflicts.

Hurry on down to your local computer store (or order from the *Personal Computing Directory* address) to buy the 1977 edition of the directory! The price is a mere \$4.95, for a 200+ page, 8 1/2 x 11 inch paperback, black and white, now available.

For further information contact Personal Computing Directory, Box 134, Harvard Square, Cambridge, MA 02138, (617) 354-1216.

CIRCLE INQUIRY NO. 288

Software

Altair BASIC Expands Computing Features

Altair BASIC's powerful features make it the most innovative and easy-to-use microcomputer language available.

8K Altair BASIC handles numeric and alphanumeric string data with a full range of arithmetic and string processing functions. It provides variable length strings (up to 255 characters) with LEFT\$, RIGHT\$ and MID\$ functions, a concatenation operator, and VAL and STR\$ functions to convert between strings and numbers.

The cassette version allows data and program files to be saved on cassette tape. Assembly language subroutines are easily interfaced by byte-oriented memory and I/O instructions.

Extended Altair BASIC adds a more complete range of arithmetic and logical operations. It provides a PRINT USING statement for formatted output, a powerful edit command for program development and debugging as well as automatic line numbering and renumbering. Extended statements and commands include: IF, THEN ELSE; LIST and DELETE program lines; SWAP variables and Trace on and Off for debugging.

Altair Disk BASIC has all the features of Extended BASIC plus the capability to support sequential and random access disc files or file maintenance utilities. Provisions for user-supplied access methods and special I/O routines are also included in the system.

Since 4K, 8K, Extended and Disk versions of Altair BASIC are available, there's no need to buy more capability than you can use or less than you need. For further information, contact MITS, 2450 Alamo S.E., Albuquerque, N.M. 87106.

CIRCLE INQUIRY NO. 246

8080 Fortran IV Compiler

Microsoft, an Albuquerque based software development firm, has announced the availability of a FORTRAN IV compiler for the 8080 microcomputer. Called FORTRAN-80, the initial release of this compiler is a full implementation to ANSI Standard Fortran with the exception of the double precision and complex data types.

FORTAN-80 provides three data types including: logical (one byte), integer (two byte), and real (four byte floating point). An extended version of FORTRAN-80 with double precision and complex data types is forthcoming.

The compiler generates pure, relocatable code (may be placed in ROM), and the runtime package may also be placed in ROM. The one-pass compiler requires less than 12K bytes of memory, and the runtime system less than 6K bytes.

A relocating linking loader is included with the FORTRAN package. Therefore, subprograms may be compiled separately and linked at load time. This also means that only the specific subprograms required are loaded (including system subprograms).

Another part of the package is a relocating assembler and an assembly language debugging program. The assembler may be used to produce FORTRAN compatible subprograms. The debugging system may be used with the load map produced by the loader to debug FORTRAN and/or assembly language programs.

Additional features of Microsoft FORTRAN-80 include:

- Multi-statement code optimization
- Mixed-mode expressions
- All standard FORTRAN library functions for reals and integers

Individual copies of FORTRAN-80 may be

purchased for \$500 including documentation. Manual \$15. OEM licenses available. For further information, contact Paul Allen, Vice President, Microsoft, 819 Two Park Central Tower, Albuquerque, N.M. 87108, (505) 256-3600.

CIRCLE INQUIRY NO. 247

New to BASIC?

Why struggle through stuffy technical manuals when your computer can teach you BASIC? Computerware Software Services (CSS) is offering software on cassette which transforms your computer into an instructor on 8K ANS BASIC. Each 5K lesson, accompanied by lesson plans, will coach and prompt you through the BASIC commands and programming techniques. Part I presents the fundamental commands (PRINT, INPUT, LET, DATA, IF-THEN, FOR-NEXT). Parts II & III teach the little understood concepts of formatting (using CHR\$, IEN, etc) as well as examples of reading and writing characters to cassette via BASIC and MIKBUG[®]. Each lesson has been professionally programmed and will run in a 12K 6800 system. Notice the savings on package purchases, too!

Part I "Understanding BASIC"	\$13.95
Part II "Extended BASIC"	13.95
Part III "More BASIC with MIKBUG [®] "	13.95
Package of Parts I & II	24.95
Total package of all 3	32.95

For further information contact Computerware Software Services, 830 First Street, Encinitas, Calif. 92024.

CIRCLE INQUIRY NO. 248

TEMPOS Multi-User, Multi-Tasking Operating System for MITS 8800 Computers with MITS Floppies

Up to 7 on-line users may access the system concurrently, using shared (re-entrant) or different tasks. In addition, background tasks are supported as queued processes. This disc-resident batch queue is executed by means of a pseudo-terminal, and the output from each task is spooled to an output disc file. Any terminal may execute multiple jobs simultaneously in the 'phantom' mode by detaching from a job once it is running and then initiating another. If any task is waiting for terminal input, the TEMPOS system will not allocate processor resources to that task.

Processor resources are allocated by a 'round-robin' or time-slice algorithm, wherein each task is allowed access to the processor for 16 milliseconds. Due to the access limitations of floppy discs, all tasks must be memory-resident. Therefore, the maximum number of possible tasks is limited by the memory space available in the machine. User assembly language programs have access to many operating system subroutines for file handling and I/O operations. The TEMPOS system supports one high-level language (OPUS/TWO), a text editor, an assembler, and a package of utility assembly language programs.

The TEMPOS system, through OPUS/TWO, supports shared-access to data files by many users, with a file 'lock' feature under program control. Extensive file handling capabilities, including user-defined logical record length and random access to file, as well as logical record-number, are featured. The user may also define the number of files to be open at one time. Programs written under OPUS/ONE are upward-compatible to run under OPUS/TWO.

A command macro feature may be invoked under the TEMPOS system, allowing an unlimited number of macros to be defined and recalled at the system and user program levels. Also, to facilitate debugging, a single-step

trace feature is included for assembly language programs.

The minimum recommended memory requirement for the TEMPOS multi-user, multi-tasking Operating System, using 2 discs and 3 terminals, is 48K. A.S.I.'s Clinical Accounts Receivable/Billing System also runs under the TEMPOS system. Availability is 30 days ARO, beginning June 15, 1977. For further information contact, Administrative Systems, Incorporated, 222 Milwaukee, Suite 102, Denver, Colorado 80206, (303) 321-2473.

CIRCLE INQUIRY NO. 249

Complete BASIC Software Package Is Integral Part of All MetaFloppy Systems

Micropolis Corporation has produced its own Disc Extended BASIC, a complete self-contained package that provides total support for BASIC programming with the new Meta Floppy systems.

The Micropolis BASIC is designed for 8080-based microcomputers having at least 24K bytes of RAM.

Activation of the MetaFloppy's built-in autoloader feature brings up the system under control of the BASIC monitor. This makes available a number of powerful commands for disc operations, including the creation, storage and loading of named program and data files.

Control of disc allocation is handled automatically by the Micropolis software.

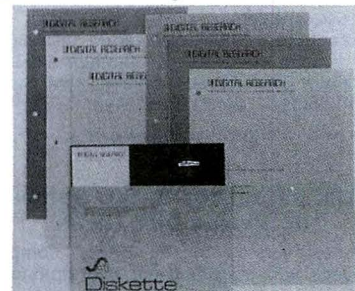
In addition to the standard BASIC statements and functions, the Micropolis Disc Extended BASIC language offers some interesting extra features. These include: a powerful Chaining capability, which permits long programs to be stored on disc in segments and called into computer memory automatically; MIN/MAX instructions to compare strings of data; and INDEX/VERIFY to work with substrings within a string.

For further information, contact Micropolis Corporation, 9017 Reseda Blvd., Northridge, CA 91324, (213) 349-2328.

CIRCLE INQUIRY NO. 250

Digital Research CP/M Low Cost Microcomputer Software

CP/M is a low-cost advanced disc operating system designed for use with IBM-compatible diskette-based computer systems which employ the Intel 8080 microcomputer. Previously available only to IEM's, CP/M has been in existence for over three years in various manufacturers' products and has undergone extensive field testing.



The functions of this software package include named dynamic files, program editing, assembly, debugging, batch processing, and instantaneous program loading, resulting in facilities similar to popular timesharing services. CP/M is an "unbundled" software package which can be easily adapted to any 8080 or Z-80 computer system with at least 16K of main memory and one or two IBM-compatible disc drives. Although the standard CP/M

system operates on an Intel MDS, the field modification manual provided with CP/M tells how to alter CP/M for other hardware configurations. Price for a complete CP/M System in object form with documentation is \$70, documentation (set of 6 manuals) alone is \$25. For further information, contact Digital Research, P.O. Box 579, Pacific Grove, CA 93950, (408) 373-3403.

CIRCLE INQUIRY NO. 251

Microprocessor Hardware/Software Services Catalog



WINCE 6800 MICROMODULES (MPU, I/O, RAM, ROM, EROM programmer, ADC/DAC, Driver/Sensor, Floppy controller, etc.) on 4 1/2" x 6 1/2" cards; 6800 cross and resident software (assembler, PL/W, relocating linker, simulator, editor, monitor/debugger, BASIC); custom systems; consulting; in-house hands on μ P courses. WINTek Corp., 902 N. 9th Street, Lafayette, IN 47904. (317) 742-6802.

CIRCLE INQUIRY NO. 252

Management Problem Solving Library

The M.P.S. library is a collection of programs dealing with investment analysis, depreciation, loans, present/future values, cash management, and other areas of financial analysis. The library is designed to be used by the non-programmer — a complete user manual is provided. The processing methodology and program flow is documented to allow modification and certification of program processing.

The library is unique in that the buyer gets not only the current version of the library but also all additions for a two year period. Library updates are issued quarterly and can be acquired for a minimal copying fee.

The M.P.S. library is available for either MITS Disk Extended or North Start BASIC. Each package consists of complete System/Program Documentation Manual and a diskette containing the programs.

All materials are copyrighted and a license agreement is required prior to receiving system updates. The programs in the M.P.S. library are available.

Introductory price \$150 (good till 6/30/77). For further information, contact Business Computer Systems, 216 Collier Drive, Springfield, Illinois 62704, (217) 787-3448.

CIRCLE INQUIRY NO. 253

ICOM Introduces BASIC Software for Floppy Disc Users

A new version of the BASIC computer language with routines and instructions optimized for microcomputers and floppy disc operating systems is now available from the ICOM Division of Pertec Computer Corporation.

The new software system, designated ICOM® BASIC-M, is simple enough so that personal computing users and hobbyists can immediately program useful applications. On the other hand, OEM customers can use the widely known BASIC language routines to program microcomputers for in-house jobs such as ac-

counting, inventory control, accounts payable and receivable, and mailing lists.

The new software is implemented through any ICOM floppy disc system and operates with any microcomputer that is based on the 8080 or Z80 microprocessors—this includes not only popular hobby computers such as the Altair, Imnai and Poly 88 units, but also such machines as the Intellec MDS-800 and Intellec 8/80.

The BASIC-M language is tailored to operate with limited memory storage and to facilitate operation with a floppy disc. Whereas standard "Dartmouth BASIC" requires at least 16k bytes of memory to operate effectively, BASIC-M needs just 8K of storage to do the same functions. Yet the instruction set is essentially the same as Dartmouth BASIC—probably the most widely understood computer language.

BASIC-M is the only version of the language that communicates directly to a floppy disc with a simple INPUT command. A program can be written and debugged at the user's terminal. When the program is running, a single command to change PRINT to INPUT TO DISK automatically alters the program for immediate loading on a floppy disc. The command is just reversed when a program loaded on disc needs to be further debugged or altered; the operator will then be able to display or print out instructions and routines for online debugging.

BASIC-M is available from stock for \$50 (plus \$10 shipping for orders outside the U.S.). Individuals may purchase BASIC-M through authorized ICOM® dealers. Industrial and OEM customers may order directly from ICOM.

For further information contact the ICOM Division of Pertec Computer Corporation, 6741 Variel Ave., Canoga Park, CA 91303, (213) 348-1391.

CIRCLE INQUIRY NO. 254

HAL Floating Point Basic

An 8K Floating Point Basic has been developed by HAL for use in the EIGHT THOUSAND system. This version of Basic relies heavily on the HAL system monitor for input/output control. Most available Basic programs will run with HAL Basic. Two-dimensional arrays of size 100 x 200 or single-dimensional arrays of 1000 elements are allowed. String variables and a comprehensive "Math Package" are also included. Coupled with the HAL EIGHT THOUSAND, this version of Basic makes the cost-effective small business computer a reality. Write or call HAL today for more information. HAL Communications Corp., P.O. Box 365, Urbana, Illinois 61801, (217) 367-7373.

CIRCLE INQUIRY NO. 255

Assembler, Editor, and Linking Loader for the TMS9900

Technico, Incorporated announces an Assembler, Editor, and Linking Loader to operate with the Super Starter System featuring the Ti TMS9900 16-Bit Microprocessor. The Assembler can be loaded from the Editor's buffer so that the source program can be assembled, edited, reassembled without using external storage devices. The linking loader provides a capability to assemble separate program modules and link them together. The output can be loaded anywhere in memory and is relocatable. This software is available on paper tape, digital or audio cassette and can also be supplied resident in E-Prom. For further information contact Technico, Incorporated, 9130 Red Branch Road, Columbia, Maryland 21045, or call Toll Free 1-800-638-2893.

CIRCLE INQUIRY NO. 256

Assembler/Operating System/Debug/Disassembler

MIKADOS — Mini Instant Keyboard Assembler, Debug, and Operating System.

MIKADOS + D retains all the powerful fea-

tures of MIKADOS plus a complete DIS-ASSEMBLER! It is specifically designed to make it easy to assemble, debug, and modify programs using a small amount of memory. MIKADOS + D occupies only 3.0K bytes of memory. With only 4.0K bytes, this still leaves 1.0K bytes for user programs and label table.

The assembler generates object code for the 72 basic variable-length instructions with all addressing mode variations (a total of 197 different instructions). The assembler instantly generates object code for user entered mnemonics, enters them into user program memory, and outputs formatted object code and address on the same line as user input. Relative addressing for branch instructions with symbolic labels are resolved and a label table is maintained.

There are eighteen useful directives which are 'on-line' at all times. This provides the user with powerful interactive capabilities including:

- 1) ASCII character I/O.
- 2) Hex character input, formatted hex character output.
- NEW! 3) Disassembly of object code into source code with complete instruction mnemonics and absolute branch addresses.
- 4) Label table formatted output.
- 5) Data transfer from one area of user memory to another.
- 6) Clearing of all or any portion of user memory.
- 7) Controlling of execution of user programs.
- 8) Setting/Clearing breakpoints.
- 9) Setting/Clearing monitor points, plus more!!

All this for *only* \$17.95!!! Order MIKADOS + D (68V2.0). Includes 28 page user manual and hex object code listing, and limited 90 day warranty. California residents add 6% sales tax. For further information contact Inpro Micro Systems, P.O. Box 7776, Van Nuys, CA 91409.

CIRCLE INQUIRY NO. 257

An Accounts Receivable System for the Small User

This system is expressly designed to be run on an 8080 based microcomputer using an ALTAIR™ floppy disk with ALTAIR™ basic, video terminal and printer. Many features normally found only on large scale computers are included. Provided are such functions as Adding New Customer Accounts, Deleting Dormant Accounts, Transaction Processing, and Report Generation. The Monthly Statements include both current and aged balances. Other reports generated are the Aged Accounts Receivable and Delinquency Notices.

This easily usable system requires very little operator training. All communication is an interactive mode with the program constantly prompting the appropriate responses. Operator errors are easily corrected and accidental data base deletions are prevented by requiring additional confirmation.

This Accounts Receivable System although supplied ready for use, may readily be modified to include special installation-dependent functions. All major programs are written in high level language making program additions and alterations a simple task. This program module is designed to serve as the basis for a complete accounting package. Provisions are included for linking Billing Inventory Control and General Ledger modules which will be available in the near future.

For further information, contact: Synchro-Sound Enterprises, 193-25 Jamaica Ave., Hollis, N.Y. 11423. (212) 468-7067.

CIRCLE INQUIRY NO. 258

Selling Software? Put It On Records!

Phonograph records . . . Are cheaper than cassettes (in quantity), have a more reliable

speed, don't have the level changes and "drop-outs" of cassettes, have a broad frequency response for high data rates, can be banded (like songs on a hi-fi recording) for visually finding a program or data and can't be accidentally erased.

We make high-quality vinyl phonograph records from your cassette (or reel-to-reel tape). Phonograph records can be 7" 45 rpm, 7"

33 rpm, or 12" 33 rpm. We can record on one or both sides of the records, and different programs on the same side can be separated by a "band" if you want, the same way different songs on a regular LP are separated with a "band."

The cost of a phonograph record is quite small. If you are a computer store, you know how well your better magazines and books sell.

Try a "Greatest Hits" package of your best software! (And don't forget the mail order sales—they always do well.)

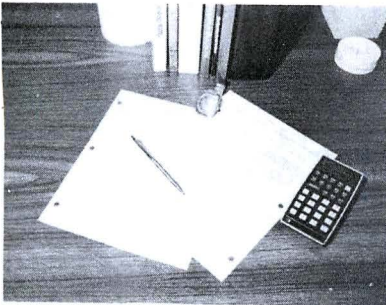
If you have questions, call or write. Better yet, send a small initial order. Good software at a reasonable price will always sell. For further information, contact: QCA, P.O. Box 1127, Burbank, CA 91507, (213) 769-6582.

CIRCLE INQUIRY NO. 259

Miscellaneous

8080 Instruction Timing Reference Cards

The Pragmatic Systems 8080 Instruction Timing Reference Card presents instruction execution times and characteristics of all 8080 instructions in a concise and easy to use format. The general timing equations for the 8080 are included along with pre-computed execution time columns for 8080 systems with a 2 MHz clock and memory access times from 0 to 1500 ns.



The back of the card contains instructions and equations for computing execution times of existing programs in any 8080 system. It also shows how to use the card to design program delay loops with specific execution times. Small sample programs are included as examples.

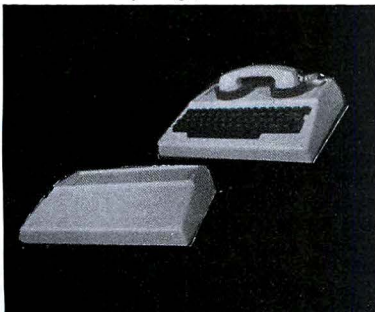
The card is printed on heavy stock and punched for three-ring binders. It is ideal for use as a notebook reference.

The card price is \$2.00 each or three for \$5.00. All orders shipped postpaid from Mt. View, CA. (California residents should add 6.5% sales tax.) Volume discounts are available and dealer inquiries are invited. Pragmatic Systems, P.O. Box 43, Mt. View, CA 94042.

CIRCLE INQUIRY NO. 260

Plastic Keyboard Enclosure

This blank molded ABS plastic enclosure is very suitable for keyboards and other applications. There is room enough for plenty of electronics, including a small computer system, if you desire. The five inch flat area could be used as a display area, for controls, for a modem or for anything you can think of.



The ABS plastic is very shock-resistant (used for telephones, auto bumpers, etc.), yet can be cut and drilled easily. Can be worked with a drill, N/C mill, router, sabre saw, motor tool, etc.

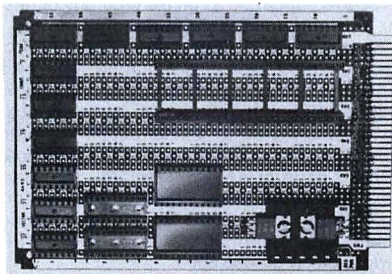
Enclosure includes bottom with screws and stick-on rubber feet. The inside size is 13 3/4" wide, 11 1/2" deep, and 2 1/2" high at the back and 1 1/2" high at the front. The flat part at the front is 5 1/2" deep. The flat level tray on top is 4 1/2" x 11 3/4". Color is either black or beige.

Can be ordered with a hole cut for the pictured keyboard, available from various sources, including Radio Shack. Delivery: Stock to 60 days. Price: Enclosure \$19.95, with cutout shown \$24.95, with keyboard shown \$49.95. For further information contact Egbert Electronics, 1514 S. 320 E, Orem, UT, (801) 224-2102.

CIRCLE INQUIRY NO. 261

High-Dip Capacity Circuit Board Family Speeds Microprocessor System Design

Four new high-DIP-capacity circuit cards, from Vector Electronic Company, provide a combination of board sizes, convenient power-bus and ground-plans organization and edge connector configurations that speed development of virtually any microprocessor CPU, memory, or interface system. Unlike other cards with restrictive bus patterns, the new Vectorcards accept all DIP sockets with 0.1 inch by 0.3-, 0.4-, 0.6-, and 0.9-inch lead spacing, and with up to 64 pins.



Two 4.5 inch wide by 6.5 inch long boards, designated 4493 and 4494 accommodate any combination of intermixed DIPS up to a maximum of forty-two 14 or 16-pin DIPS, twenty-four 22-pin DIPS plus six 16-pin DIPS, sixteen 24-pin DIPS plus six 16-pin DIPS. For more extensive systems the model 4493-1 and 4494-1 boards are 4.5 inches wide and 9.6 inches long. These boards accept up to sixty-three 14-pin or 16-pin DIPS, forty-two 22-pin DIPS plus nine 16-pin DIPS, twenty-four 24-pin DIP plus nine 16-pin DIPS. Even with high-density chip arrangements, there is sufficient space for on-board voltage regulators and discrete components. The 4493 and 4493-1 have 72 edge contacts (36 per side) on 0.1 inch spacing while the 4494 and 4494-1 have 44 contacts (22 per side) on 0.156 inch spacing.

In single unit quantities, the 4493 and 4494 sell for \$14.95; delivery is from stock. The 4493-1 and 4494-1 sell for \$16.95; delivery is stock to 30 days. For further information contact Vector Electronic Company, 12460 Gladstone Ave., Sylmar, CA 91342, (213) 365-9661; TWX (910) 496-1539.

CIRCLE INQUIRY NO. 262

Soft Touch™ Tone Dialer

The "Soft-Touch"™ tone dialer is compatible with all Western Electric telephone handsets. The tone dialer gives the user instant tone capability from any standard rotary dial telephone.

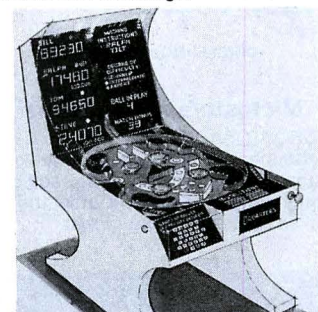


Soft-Touch uses LSI circuitry equivalent to 4,000 transistors. Electret microphone gives .1% distortion for error free modem use. Unique design allows you to softly touch the face panel to generate the exact tones used to place telephone calls or to input or control equipment remotely. For further information contact: Telephone Electronics Corporation, 615 Third St., San Francisco, CA 94107.

CIRCLE INQUIRY NO. 263

Futuristic Pinball Machines Use Microprocessors and Gas Discharge Displays

Electronic pinball machines extend the conventional game with heightened play action, excitement and challenge.



Players control flippers to keep the ball away from the outsole. While the ball is in play, magnetic sensors beneath the playfield surface activate switches that control gates, bumpers, rubber bounce straps and kick levers.

Scoring accumulates immediately in glowing orange from large-area, gas discharge display score panels. From a built-in keyboard players can enter their names and choose to play on expert, beginner, or intermediate levels, which modifies the game's speed and difficulty.

Circuitry also orchestrates electronic sound effects and flashing lights with game action.

The total effect is futuristic, but designers at Beckman Information Displays Operations say the technology exists now. Their concept of electronic pinball games incorporates large,

screened-on-glass, gas discharged displays, as shown in this artist's view. Beckman Instruments, Inc., Information Displays Operations, P.O. Box 3579, Scottsdale, Arizona 85257; (602) 947-8371.

CIRCLE INQUIRY NO. 264

Fickled Thinking Aids

Now you can document for ADPS as fast as your ideas flow AND record your documentation at every step! FICKLED THINKING AIDS are ready for the office copy machine anytime you are. Make changes... but record the documentation at every step so if you have to unchange a change the original thought won't be lost.



FICKLED documents are composed by pressing supple plastic symbols onto a proprietary worksheet. Write on the symbols and worksheets with a ball point pen (or any writing instrument used on plastic). If you need a change, peel off the symbol, rub-out the flowlines, re-stick the symbol and re-draw the flowlines. You may peel off, rub-out, re-stick and re-draw as many times as you need or want.

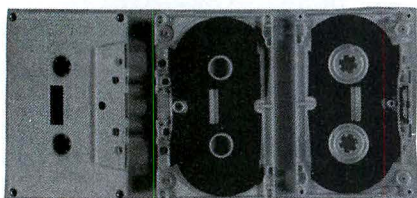
The symbols are precision cut from a special supple plastic material. Each sheet of symbols has a stiff paper backing so you may write on many symbols before sequencing them on the worksheet. The symbol pads also have a protective cover sheet illustrating the symbols with their nomenclature. There are 486 symbols per pad.

The ADPS "Starter Kit" (#SKA-075) includes the FOLDER, a pad of 10 L size WORKSHEETS and a pad of 3/4 size ADPS SYMBOLS. It sells for \$8.95 Plus \$1.50 shipping (\$10.45). For further information contact: C. C. Cunningham at (714) 639-9061 collect.

CIRCLE INQUIRY NO. 265

Microstorage Cassettes™

MICROSTORAGE CASSETTES® is the first cassette storage media product designed and packaged exclusively for the storage of microcomputer programs utilizing either the audio or digital cassette recording format.



Microstorage Cassette® cartridges are loaded with the highest quality, wide bandwidth, low noise, ferric oxide, normal bias cassette tape available on the market today. Superior long term recording-playback performance is achieved using this tape for storing microcomputer programs in either the audio recording or digital recording format.

The Microstorage Cassette® cartridge is a deluxe shell of five screw take-apart construc-

tion and contains polyolefin washers and roller guide posts for perfect even-tensioned tape winds and extended media life. This take-apart shell assembly is fabricated with a specially engineered phosphor bronze pressure pad to inhibit cassette tape skewing during high speed recording and rewind operations.

Microstorage Cassettes are available in MC-15, MC-30, MC-45 and MC-60 cassette lengths.

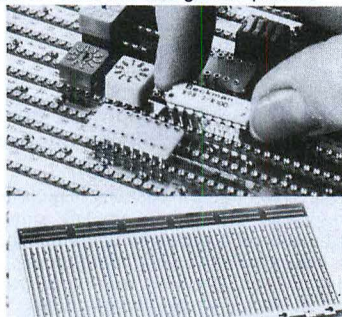
PRICE	MC-15	MC-30	MC-45	MC-60
1-9	\$1.35	\$1.60	\$1.90	\$2.40
10-24	1.25	1.45	1.70	2.15

OEM quantities available to dealers. One time/customer evaluation sample package prepaid price is \$27.50 and includes 5 MC-30, 5 MC-45 and 5 MC-60 MICROSTORAGE CASSETTES. This sample package cost also includes postage and handling cost within the U.S.A. Dealer/Letterhead inquiries invited. Contact Microcomputer Software Depository, 2361 E. Foothill Blvd., Pasadena, CA 91107, (213) 449-0616.

CIRCLE INQUIRY NO. 266

Universal Pattern Wire Wrap Panels

Designed to hold any combination of 8, 14, 16, 18, 20, 24 and 40-pin integrated circuit, EECO UG Series panels feature two ounce copper on both Vcc and ground planes.



The panels have one to six sections. Each section has nine socket-terminal rows. The rows are on 0.3" spacing with 50 socket-terminals per row. There are 42 sleeves per section for connecting Vcc and ground to the integrated circuits. Three different I/O connector area patterns are available.

Socket-Terminal contacts are Beryllium copper with gold over nickel plating. Wire wrap pins are phosphor bronze, gold over nickel plating. All boards are 1/8 inch flame retardant glass epoxy with 2 ounce copper circuitry, solder coated on both sides. Largest board size (six pattern) is 6.875" x 16.175". Delivery is from stock; unit price starts at \$243.00 for a six-pattern panel. EECO, 1441 East Chestnut, Santa Ana, California 92701 or Phone "EPP Products", (714) 835-6000.

CIRCLE INQUIRY NO. 267

Vending Machines

Credit is displayed and multiple prices are offered with new coin changers.



By employing advanced microcircuits, the latest vending machines are adding features that promise to increase sales and decrease consumer frustration.

The microcircuits have enabled National Rectors Industries, the world's leading manu-

facturer of coin and currency handling machines, to produce the most sophisticated coin changing systems used in vending machines.

The new generation of NRI electronic changers accepts both coins and dollar bills; they permit multiple selections of items at up to 10 different prices; they display the amount deposited, and, as selections are made, a declining balance is displayed.

NRI's new XL-Series changers will vend products ranging in price from \$0.05 to \$3.15. They return change faster than other changers, and a bill validator option (NRI's Buckpasser unit) can be added by merely plugging it in. Use of the machine to make change for larger coins without buying a product is prevented by returning the same coinage, released when the coin return lever is operated.

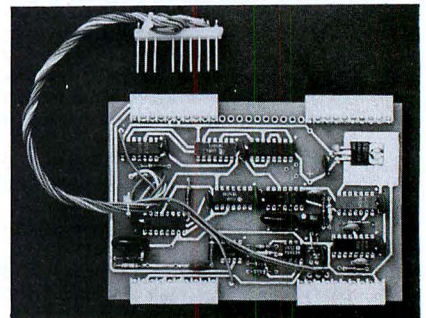
The custom-designed integrated circuits have permitted NRI to add the advanced features while minimizing space requirements, controlling costs, and maintaining high reliability by minimizing mechanical parts, reports the company. The circuits are being produced by American Microsystems, Inc. (AMI) of Santa Clara, California.

For further information, contact American Microsystems, Inc., 3800 Homestead Rd., Santa Clara, CA 95051, (408) 246-0330.

CIRCLE INQUIRY NO. 268

Prototype Cards for 6800 SWTPC Bus

Two Prototyping boards for either wire wrap or soldertail and wiring pencil are now available from Personal Computing Company, Dallas, Texas. These boards are either I/O size or memory size. They are compatible with the SWTPC bus structure and mother board as they use the molex type connectors at the bus interface. In addition other connectors are provided to allow off board and I/O functions.



The cards are arranged in rows of holes with the holes on 0.1" centers and the rows on 0.3" centers, no pads are dedicated to either power or ground. However, power and ground bus is generously provided through out the card. Bypassing locations are provided to assure stability of the two regulators which can be installed in their special locations. (Note: The I/O size card only has provision for one regulator.)

The memory size card is only \$19.95 postage paid and the I/O size card is only \$9.95 postage paid. For further information, contact: Personal Computing Company, 3321 Towerwood, Dallas, TX 75234.

CIRCLE INQUIRY NO. 269

DIP-1 DIP Pin Out Self-Adhesive Labels

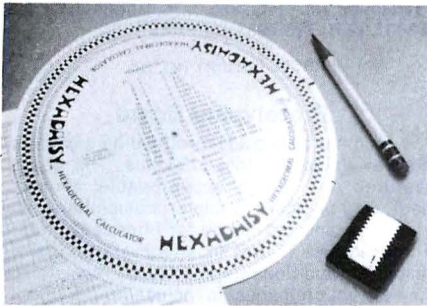
For hobbyists and professional who use "Wire-Wrapping" techniques. The product is simple and yet, a time-saver. It consists of a sheet of clear mylar imprinted with the appropriate pin out patterns of commonly used dual-in-line packages. Self-adhesive labels are cut out and applied to the wiring side of the bread board between the rolls of the socket. Thereby positively labeling each socket pin. If you have done any wire wrapping on circuits containing a dozen or more packages, you will immediately recognize the benefit inherent with this product.

The DIP-1 DIP PIN OUT LABELS sheet (8½ x 11) is priced at \$5.95 each, post paid to any U.S. address. For further information, contact ADTECH, P.O. Box 10415, Honolulu, Hawaii 96816, (808) 941-0708.

CIRCLE INQUIRY NO. 270

HEXADAISY™

HEXADAISY™, a hexadecimal calculator was introduced at the First West Coast Computer Faire in San Francisco. The device calculates the offset for relative addressing as used by the 6800, Z 80, 6502, SC/MP and F 8 microprocessors, adds and subtracts hexadecimal numbers, calculates 2's complements and converts decimal to hexadecimal numbers and back. All results within the range of 0 to 255 (decimal) can be read directly while larger numbers are calculated two hexadecimal digits at a time.

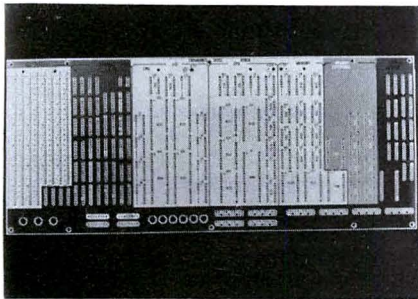


HEXADAISY™ is made from sturdy plastic in the form of a circular sliderule with waterproof printing and comes with complete instructions. Available for \$3.95 (ppd) from E. & L. Pfeiffer, Computer Products, Box 2624, Sepulveda, CA 91343 or from local computer stores. For further information contact: Erich A. Pfeiffer, 16526 Buchet Drive, Granada Hills, CA 91344, (213) 368-3996.

CIRCLE INQUIRY NO. 271

Custom Augat Board Simplifies Intel 8080A CramerKit Assembly

The custom board, manufactured exclusively for Cramer by Augat, Inc. of Attleboro, Mass., features quick and easy assembly due to its comprehensive color coding and product numbering systems coupled with the plugability of Augat's precision packaging socket board.



Users can assemble the Intel 8080A Cramerkit "by the numbers" since all the product numbers in the kit are clearly spelled out on the top side of the socket board next to their correct pin insertion points. There are seven identified function areas broken down into four color-coded areas for "step-by-step" assembly of the microprocessor. These seven areas include CPU, memory, I/O, display control, Cramerkit I/O, memory expansion, and logic expansion.

The four basic colors — yellow, light blue, dark blue, and brown — correspond to the function areas called out on a wall-size logic diagram which is part of the documentation package included in each Cramerkit.

The socket board consists of Augat's two piece, machined contact assembly (3-level, wirewrappable pin). This allows the user to

simply plug-in all the components of the Intel Cramerkit in minutes without the usual problems associated with PC boards.

The silk-screened boards are available in two versions: unwrapped (model X8136-MP3-C-GF) at \$275.00 or wrapped (X8136-MP3-WC-GF) at \$325.00. A clear, plexiglass bottom cover is provided for the protection of the contact pins on both versions.

For further information contact Cramer Electronics, 85 Wells Ave., Newton, Mass. 02159, (617) 969-7700.

CIRCLE INQUIRY NO. 272

Stereo Phono-Input Interference Filter

A newly designed Stereo Phono-Input Interference Filter has been introduced by Electronic Specialists. Personal computer interference often enters a stereo or hi-fi system through the phono or cassette input cables.



Designed to plug directly into the amplifier input jack, a filter in each amplifier input will greatly reduce or eliminate phono-input interference. \$7.95 per pair.

For further information contact Electronic Specialists, Inc., Box 122, Natick, Mass. 01760.

CIRCLE INQUIRY NO. 273

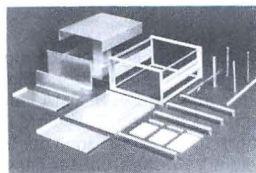
Custom Keyboard Mounting Plates

Custom keyboard mounting plates for Enclosure Dynamics cases Model VTE, TVT, and KBE enclosures are available with keyboard cutouts for SWTPC's Model KBD-5 keyboard and Control Development's Model 6000 keyboards. The mounting plates are available at no extra charge when cabinet is purchased. For further information, contact Enclosure Dynamics, Inc., P.O. Box 6276, Bridgewater, NJ 08807, (201) 725-7982.

CIRCLE INQUIRY NO. 274

Flex-i-pak Instrument Case

This case, tradenamed "Flex-i-pak," is supplied in a basic unit/frame configuration with a variety of chassis and brackets to choose from as needed. This allows custom-designing of prototype units with a minimum cost without tooling. It's also a sturdy, economical case for production run equipment.



Since Flex-i-pak extrusions, brackets and panels contain a pattern of holes on ½" centers, an almost infinite number of configurations is possible. Card guides may be installed in a variety of modes and spaced for popular connector lengths.

The basic case features vinyl covered top

and bottom, side rails and perimeter frame of extruded aluminum. Standard case width is 17" with 13", 16" or 20" depths. Heights are 3½", 5¼", 7", 8¾", 10½" and 12¼".

Flex-i-pak is available at a basic-unit cost, 1-4, \$72.00 to \$145.00 each. For complete specifications, contact Richard Osborne, V.P. Marketing, at The Buckeye Stamping Company, 555 Marion Road, Columbus, Ohio 43207, (614) 445-8433.

CIRCLE INQUIRY NO. 275

MCA Extension Cables Extend Terminal Use

Minicomputer Accessories, Palo Alto, Calif., now offers extension cables for intelligent terminals and all EIA RS 232 C compatible terminals including the HP 2640 Series. The cables, designed for local use, are available in both 50 and 100 foot lengths which enable users of multi-terminal systems to locate terminals near users.

Models 1500 (50') and 1510 (100') EIA RS 232 C cables for all EIA compatible terminals and junction panels include 25-pin female connector with hood on one end and 25-pin male EIA connector and hood on the other. These cables are also compatible with MCA 1230 junction panels which enable DGC ALM/SLM communication system owners to connect up to 16 terminals with 25-pin EIA RS 232 C connectors. Models 1350 (50') and 1360 (100') cables for HP 2630 to EIA terminals include 30-pin HP type connector and hood on one end and 25-pin male EIA connector on the other.

For more information about MCA extension cables, write MCA 1015 Corporation Way, P.O. Box 10056, Palo Alto, CA 94303.

CIRCLE INQUIRY NO. 276

"ZIF"

The Cannon® DL "ZIF" (Zero-Insertion-Force) series fills a need in the commercial/ industrial, computer and peripheral equipment marketplace for low-cost, high performance multiple-wire power and signal connectors.



DL "ZIF" connectors feature a minimum rated life of 10,000 complete mating and unmating cycles with no performance loss. They can be mated and unmated in less than two seconds even with as many as 2,496 contacts, and cost less (often as much as 25% less) per mated line than competitive high-density rack-and-panel connectors.

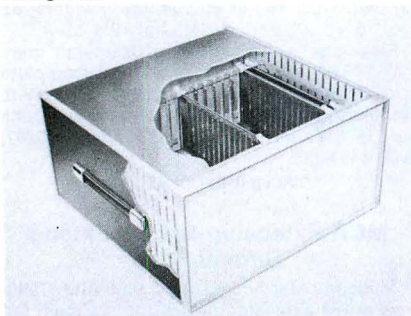
For further information, contact Cramer Electronics, 85 Wells Avenue, Newton, Mass. 02159, (617) 969-7700.

CIRCLE INQUIRY NO. 277

Colorful Enclosures: Ideal and Inexpensive for Microcomputer Development

A new line of enclosures, from Vector Electronic Company, combines aesthetic styling with a versatile interior mounting structure that provide easy accessibility to interior components. Called VECTOR-PAK, the enclosures panels are available with clear- or black-anodized aluminum finish or with mar-resistant textured vinyl covers in many standard colors. Many "off-the-shelf" interior structures may be ordered with the enclosures pro-

viding adjustability and strength of design throughout.



Available in a wide range of sizes, Vector Pak Enclosures have assembled models tailored for the ALTAIR™ and IMSA™ types (card and power supply configurations with 12 card positions, installed), with prices in the \$110.00-\$120.00 range. Sloped front panel models are also available for keyboard application. Enclosures without interior structures are priced from \$65.00 to \$95.00. Delivery is stock to one week for standard items; four weeks for custom units.

The units find applications in laboratory equipment, instruments, computers, peripheral controllers, and development systems. A variety of optional card guides, brackets and straps permit convenient installation of cards, modules, electronic components or electro-mechanical assemblies from the front top or rear with either horizontal or vertical orientation. For further information contact Vector Electronic Co., 12460 Gladstone Ave., Sylmar, CA 91342.

CIRCLE INQUIRY NO. 278

New Cover for SWTPC PR-40 Printer

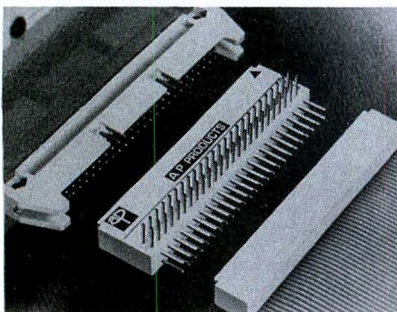
Parsec Electronics announces its newest enclosure in support of SWTPC products. This cover, made of high strength, scratch-resistant ABS plastic, fully encloses and protects the PR-40 printer and reduces operating noise substantially. Its black, semi-gloss finish matches the keyboard and terminal enclosures already offered by Parsec.

The PR-40 printer cover is available from stock and is priced at \$19.95 plus \$1.50 for shipping and handling. For further information, contact Parsec Electronics, P.O. Box A82327, San Diego, CA 92138, (714) 276-3255.

CIRCLE INQUIRY NO. 279

Intra-Connectors™

A P Products Incorporated of Painesville, Ohio, is introducing a versatile new product that should prove a great aid to people using or designing with flat ribbon cables and standard double-row socket connectors.



The product, Intra-Connector™, consists of a standard female double row socket connector and two sets of mating male contact pins, at right angles to each other.

Intra-Connector can be used to expand upon existing systems by residing as a line "tap," the full cable wide. Thus daisy chains can be built into existing systems quickly and easily. Here, Intra-Connector performs as an equivalent to the cube tap.

Intra-Connector is available in the five most

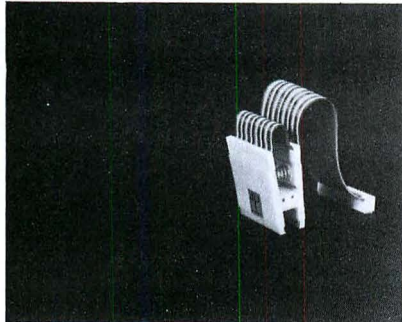
popular flat ribbon cable line widths to work immediately with the bulk of all of today's systems: 20, 26, 34, 40 and 50 contacts (lines) wide.

Intra-Connector is available from A P Products distributors, who can be located through the company's toll-free Faster And Easier Line, (800) 321-9668. Or write A P Products, Box 110, 72 Corwin Drive, Painesville, Ohio 44077.

CIRCLE INQUIRY NO. 280

The Logical Connection

A P Products Incorporated (Painesville, Ohio) is introducing a new way to reach from logic analysis systems to individual outboard DIP ICs mounted on PCBs, socket panels, test socket boards and so forth.



The Logical Connection is a special version of A P's popular Great Jumpers. Like Great Jumpers, The Logical Connection comes fully pre-assembled and fully pre-tested with molded-on connectors that feature integral strain relief and line-by-line probeability.

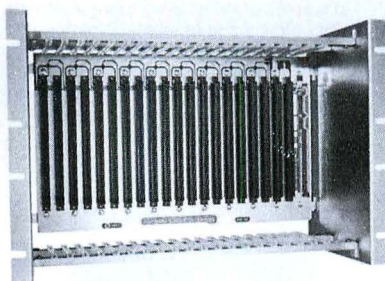
The Logical Connection translates the pins atop A P's IC Test Clip into a standard double row flat cable socket connector through any desired length of Great Jumpers ribbon cable. This cable is available in either Electric Pink (characteristic of the Great Jumpers line) or with a double rainbow encoding, individually on one side and in groups of ten on the reverse.

The Logical Connection is available in standard configurations from stocking A P distributors. Custom configurations are available, too, from A P reps or the factory. The name of the nearest A P Products rep or distributor can be found through the company's toll-free Faster and Easier Line, 800-321-9668.

CIRCLE INQUIRY NO. 281

ECT-100 Microcomputers

ECT-100 microcomputers are engineered for use in dedicated control applications, turnkey systems or other microcomputer systems applications.



The ECT-100 card cages are of rugged construction and fit the industry standard 19" cabinetry occupying 7 RETMA increments (12.25" high) and 8" deep. They hold 20 printed circuit boards 10 x 5.3 on 3/4 inch centers which are removable from the front for easy accessibility. Optional 30 amp power supply mounts directly on the back of the card cage. The bus structure is the standard 100 pin bus of the personal computers (Altair™ bus or S-100 bus) with bus termination and ground plane for noise reduction. A wide variety of cards are available from many manufacturers.

ECT-100 Card Cage and Mother Board \$100. kit ECT-100 w/full set of connectors and guides.....\$200. kit

ECT-100-8080 An 8080 Card Cage

Microcomputer\$320. kit

ECT-100-280 A 280 Card Cage

Microcomputer\$420. kit

For further information contact Electronic Control Technology, P.O. Box 6, Union, New Jersey 07083, (201) 686-8080.

CIRCLE INQUIRY NO. 282

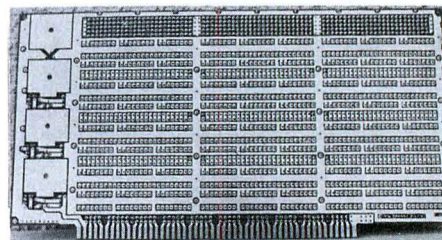
VTE 102 Enclosure for 9-Inch CRT

The VTE 201 is the same design and of the same quality as our VTE 101 except for its smaller CRT top cover scaled to fit a 9-inch display. Price: \$73.95 in one of our three standard paint finishes and \$67.95 unpainted. For further information contact Enclosure Dynamics, Inc., P.O. Box 6276, Bridgewater, NJ 08807, (201) 725-7982.

CIRCLE INQUIRY NO. 283

Prototyping Board

A commercial grade prototyping board is now available for the S100 bus. The board features on all wire wrappable format, dedicated on-board regulator, prenumbered IC locations, and provisions for filter capacitors. Three etched TO-220 locations are program-mable for additional regulators or transistors. An instruction manual is included.



Interface connections are handled through provisions for flat cable connectors. The board will accommodate up to 81 14 or 16 pin sockets, up to 24 18 or 24 pin sockets or up to 12 26 or 40 pin sockets. The layout is well suited for OEM applications. Price for single quantities is \$39.95, delivery is from stock to three (3) weeks.

For further information contact Orange Digital Electronics, P.O. Box 2311, Mission Viejo, CA 92675.

CIRCLE INQUIRY NO. 284

Free Mother Board

This 8 slot Mother Board was designed for use with 44Pin 4K RAM boards, which operate plugged into it forwards or backwards. LARGE voltage and ground plane on opposite sides act as a capacitor to suppress noise. 50Pin end connector compatible with molex pins, 3M scotchflex connector or flat cable can be soldered directly. Numerous spare pins are provided to bring in other signals to customize your system and provide you maximum flexibility.

This board with 4 connectors (gold, of course) is FREE with the purchase of four 4K low power RAM boards at \$79.95 each, or the board may be purchased separately for \$20.00 and \$2.50 for each connector desired. This mother board is compatible with our 4K low power Prom Board and numerous I/O boards to be announced.

See our ad in this magazine: ATWOOD ENTERPRISES or contact Kathryn Atwood Enterprises, P.O. Box 5203, Orange, CA 92667.

CIRCLE INQUIRY NO. 285

BOOK REVIEW

A COLLECTION OF PROGRAMMING PROBLEMS AND TECHNIQUES

H. A. Maurer and M. R. Williams.
Prentice Hall, Inc., 1972.
256 pages, \$12.95 paper.

Review by
Judy Scolney Robertson and
Larry Robertson

A Collection of Programming Problems and Techniques is a conglomeration of every computer science instructor's favorite problems. The *Collection* includes games (chess, tic-tac-toe, Nim, etc.), equations, sorting, cryptography, random numbers, input-output problems, recursion, statistics, and plotting (both with plotter and with line printer). This book is packed full of odd bits of information about prime numbers, Fibonacci numbers, series, equations, statistics, and number theory. The authors have included a large group of problems that are as much fun to read as they are to solve, especially in the chapters "Chess and Other Games," "plotting," and "Advanced Problems." Most of the exercises are real mind-stretchers, and solutions require following the authors' advice to "just let your imagination roam." Thankfully, Maurer and Williams have been considerate enough to include an appendix of solutions and an index. Even though they claim each problem has a solution, the answer may not be easy to discover. And having the answer in hand can sometimes be even more confusing when it comes to determining how the solution was arrived at.

This book is not only a collection of problems. It also has a set of algorithms and suggested procedures to aid in solving these and other data processing problems. One of the most useful parts of the *Collection* is the list of admonitions as to what types of problems should not be touched by the programmer with any length pole.

Collection contains many reminders of problems encountered in ad-

vanced algebra, geometry, trigonometry, and introductory calculus courses. The formulas are the same—only the approach is different. Different enough to make *A Collection of Programming Problems and Techniques* a pleasant intellectual challenge piquing the curiosity and imagination of any who may pick up this book.

COMPUTER DICTIONARY

Donald D. Spencer.
Camelot Publishing Co., 1977.
160 Pages, \$9.95 Cloth, \$5.95 Paper.

Review by
Judy Scolney Robertson and
Larry Robertson

Computer Dictionary is a fairly complete glossary of about 2000 commonly used computer industry terms interspersed with biographical data about various historical figures of importance in computer development. The book begins with "abacus" and ends with "Zuse, Konrad." Scattered throughout the *Dictionary* is a nice collection of cartoons and photos illustrating some interesting and often unexpected computer applications.

The *Dictionary* is designed to be "a basic reference book for all students of computer science/data processing in schools and colleges." It is also a valuable reference for the teacher or businessman who has some meaningful contact with computers or data processing people in his professional life. But, best of all, this book would be a marvelous aid to the non-computer-oriented (computer-disoriented?) spouse and family of the computer hobbyist who are constantly plagued by a total lack of comprehension of the buzz words and acronyms so casually bandied about by the avid computerist.

Spencer provides clear concise definitions, cross referencing where additional information would improve understanding. An example of this is the existence of individual definitions for "moveable head disc" and "floppy disc" with cross references to the general term "magnetic disc."

The introduction contains a list of 28 basic computer terms ranging from "algorithm" and "assembler" through "compiler," "flowchart," on-and off-line, right on to "software," and finally, "terminal." The book is truly a programmer-oriented dictionary, by no means to be confused with a dictionary specifically for the hardware type. For example, "AC" is defined as "An acronym for *Automatic Computer*." "DC" is not defined at all. This is by no means a drawback to this handy guide to DP terminology.

The biographical data of such personalities as Watson, von Neumann, Babbage, and Boole will keep any computer history buff satisfied. And the well-stated definitions will be a boon to anyone from the high school student taking his first course in computer programming to the manager of a large data processing installation.

Although it is not the be all and end all in detailed technical data, Donald D. Spencer's *Computer Dictionary* definitely rates as an asset to the computer library of individual, school or business.

Formerly a programmer, systems analyst and technical writer, Judith (Judy) Scolney Robertson started her career in data processing with the Air Force where her mathematics degree from UC (Berkeley) and communications training made her an ideal candidate for programmer training. She has designed, programmed and installed systems for message switching and business applications and written documentation and developed training procedures for commercial and interactive graphic packages on both large (second and third generation) computers and minis.

Originally a physics major at University of Oregon, Larry D. Robertson became "hooked" on computers soon after enrolling in a data processing course. He has used a wide variety of machines and languages in both scientific and commercial applications. Mr. Robertson has used IBM 360's, a wide variety of minis, and miscellaneous other machines. His knowledge of physics, mathematics and electronics has been extremely valuable in interfacing software with hardware.

Software Section

SUMMARY OF SOFTWARE PROGRAMS FOR JULY

The software round up for this month's issue of INTERFACE AGE includes seven software articles, featuring one software development program, one I/O driver program, two equipment test application programs, one game program and two software package summaries. These programs and summaries include the following:

- A Diablo Output Driver Routine (see Feature Section, page 22) by Chris Terry provides the needed software for interfacing a Diablo printer to your 8080 microcomputer.
- An 8080 INTEL Hex Format Paper-Tape Dump Program by Alan R. Miller provides a needed program to dump 8080 microcomputer object code to paper tape in the INTEL standard HEX format.
- MEMTEST—A better 6800 Memory Test program by Ed Keith provides the needed diagnostic software to locate bridged RAM address lines automatically.
- A PIA Test Program by William C. Wray of Motorola provides a diagnostic program to verify functional operation of on board 6800 PIA I/O IC's.
- BOWL, a BASIC game program by Bud Shamburger provides us with an 8080 game to play in our free time during the next month.
- In addition, I have summarized two development software packages at the marketplace and available from MSD. These two programs are Nordin Enterprises 8080/Z80 Disassembler Software Package FNOCD and D&M's 8080 Software Operating System Software Packages TCOS (Tape Cassette Operating System), PTOS (Paper Tape Operating System), and DOSE (Disc Operating System Extension for the North Star floppy disc system).

MICROCOMPUTER SOFTWARE DEPOSITORY PROGRAM LISTING PRICE

THE FOLLOWING LISTS SOFTWARE AVAILABLE FROM MSD ON A PREPAID BASIS ONLY. THE TOTAL COST OF EACH PACKAGE IS THE SUM OF THE BASIC PRICE + CALIFORNIA SALES TAX, IF APPLICABLE, + POSTAGE AND HANDLING COST. FOREIGN SUBSCRIBERS PLEASE NOTE THE DIFFERENT MAILING COST FOR POSTAGE OUTSIDE USA. ADDRESS ALL INQUIRIES TO

MICROCOMPUTER SOFTWARE DEPOSITORY
2361 E. FOOTHILL BLVD.
PASADENA, CALIF., 91107
OR CALL (213) 449-0616

MICROCOMPUTER SOFTWARE DEPOSITORY (MSD) PROGRAMS DATE JULY 1977 REV.0

PROGRAM MEDIA	NOTES
PTAC PAPER TAPE ASSEMBLY CODE	* CALIF. SALES TAX REQUIRED
PTSC PAPER TAPE SOURCE CODE	FROM RESIDENCE OF CALIF.
PTOC PAPER TAPE OBJECT CODE	: USA POSTAGE + HANDLING OR
PTBC PAPER TAPE BASIC CODE	THIRD CLASS USA POSTAGE +
PTAL PAPER TAPE ASSEMBLY LISTING	HANDLING OR SURFACE RATE
PTSL PAPER TAPE SOURCE LISTING	FOREIGN POSTAGE @
PTOL PAPER TAPE OBJECT LISTING	THREE TIMES THIRD CLASS
PTOD PAPER TAPE OBJECT DUMP	USA POSTAGE RATE/STANDARD
PTBL PAPER TAPE BASIC LISTING	OR SURFACE RATE FOREIGN
CTAL CASSETTE TAPE ASSEMBLY LISTING	POSTAGE @ FIVE TIMES USA
CTSL CASSETTE TAPE SOURCE LISTING	POSTAGE RATE (ALTERNATE)
CTOL CASSETTE TAPE OBJECT LISTING	> NEW PROGRAM LISTING
CTOD CASSETTE TAPE OBJECT DUMP	% VENDOR SOFTWARE PACKAGE -
CTBC CASSETTE TAPE BASIC CODE	
CTBL CASSETTE TAPE BASIC LISTING	
HCAC XEROX HARD COPY OF ASSEMBLY CODE	
HCSC XEROX HARD COPY OF SOURCE CODE	
HCOC XEROX HARD COPY OF OBJECT CODE	
HCBC XEROX HARD COPY OF BASIC CODE	
HCAL XEROX HARD COPY OF ASSEMBLY LISTING	
HCAF FULL SIZE XEROX HARD COPY OF ASSEMBLY LISTING	
HCAL XEROX HARD COPY OF SOURCE LISTING	
HCOL XEROX HARD COPY OF OBJECT LISTING	
HCOD XEROX HARD COPY OF OBJECT DUMP	
HCBL XEROX HARD COPY OF BASIC LISTING	
TEXT XEROX HARD COPY OF PRINTED TEXT	
PTTL PAPER TAPE TEXT LISTING	
CTTL CASSETTE TAPE TEXT LISTING	
MAN MANUAL	
HGCR XEROX HARD COPY OF GRAMMAR	
PTGR PAPER TAPE COPY OF GRAMMAR	
BBSL XEROX HARD COPY OF BINARY BOOTSTRAP LOADER	
HBSL XEROX HARD COPY OF HEX BOOTSTRAP LOADER	
PACK PACKAGE PRICE INCLUDES ALL ITEMS/PROGRAM # WITH SYMBOL <	

FDD FLOPPY DISC OBJECT DUMP
SUFFIX C= HAND ASSEMBLED CODE
SUFFIX L= COMPUTER FORMATED LISTING
SUFFIX D= CODE DUMP IN OCTAL OR HEX
SUFFIX F= FULL SIZE COPY

DEFINITIONS:

ASSEMBLY LISTING: COMPUTER ASSEMBLED SOFTWARE PROGRAM LISTING THAT INCLUDES SYMBOLIC ASSEMBLY LANGUAGE SOURCE CODED INSTRUCTIONS WITH COMMENTS PLUS EQUIVALENT MACHINE LANGUAGE OBJECT CODED INSTRUCTIONS AND MEMORY ADDRESS ASSIGNMENTS FOR EACH INSTRUCTION (SOURCE + OBJECT).

ASSEMBLY CODE: SAME CONTENT AS ASSEMBLY LISTING BUT HAND ASSEMBLED.

SOURCE LISTING: SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT INCLUDES ASSEMBLY LANGUAGE SOURCE CODED INSTRUCTIONS WITH COMMENTS. SOMETIMES, LINE STATEMENT NUMBERS ARE INCLUDED FOR EACH INSTRUCTION.

SOURCE CODE: SAME CONTENT AS SOURCE LISTING BUT HAND ASSEMBLED.

OBJECT LISTING: SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT ONLY INCLUDES MACHINE READABLE OBJECT CODED INSTRUCTIONS AND MEMORY ADDRESS ASSIGNMENTS.

OBJECT CODE: SAME CONTENT AS OBJECT LISTING BUT HAND ASSEMBLED.

HARD COPY: XEROX OR PRINTED COPY.

CODE: HAND ASSEMBLED CODE (SOURCE, OBJECT, OR ASSEMBLY CODE).

LISTING: COMPUTER FORMATED LISTING.

DUMP: COMPUTER MEMORY DUMP.

MSD PROGRAMS

CPU TYPE	SYMBOLIC NAME	DESCRIPTIVE NAME	MSD # & MEDIA	P R A E C V K #	PRICE IN \$ +CALIF. TAX(*) +USA POSTAGE(†)
6502	APPLECD	6502 APPLE COMPUTER DISASSEMBLER BY ALLEN BAUM & STEPHEN WOZNAK-INTERFACE AGE, SEPT. 1976, VOL.1, #10.	1-TEXT < 1-HCAL < 1-PACK †		5.00+0.30+1.00 INC. WITH TEXT
8080	LPTIHF	LOAD 8080 PAPER TAPE IN INTEL HEX FORMAT BY BURT HASHIZUME-INTERFACE AGE, OCT. 1976, VOL.1, #11.	2-PTAL < 2-PTOD < 2-TEXT < 2-HCAL < 2-PACK †	0	8.00+0.48+2.00 INC. WITH PTAL 3.00+0.18+1.00 INC. WITH TEXT
8080	BFWOA	8080 BINARY FILES WITH OPTIONAL AUTOSTART BY WILLIAM H. JORDAN-INTERFACE AGE, OCT. 1976, VOL.1, #11.	3-PTAL < 3-PTOD < 3-TEXT < 3-HCAL < 3-PACK †	0	8.00+0.48+1.00 INC. WITH PTAL 3.00+0.18+1.00 INC. WITH TEXT
6800	MINOPS	MIN OPERATING SYSTEM BY ED KEITH & DENNIS HESCOX-INTERFACE AGE, OCT. 1976, VOL.1, #11. PTAL+ INCLUDES OPERATING INSTRUCTIONS, PAPER TAPE FORMAT AND SAMPLE RUN	4-PTAL < 4-PTOD < 4-TEXT < 4-HCAL < 4-PACK †	0	8.00+0.48+2.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH TEXT
8080	DBBDP	DR. BEATTIE'S BASIC DIET PLANNING BY DR. BEATTIE-INTERFACE AGE, OCT. 1976, VOL.1, #11.	5-TEXT < 5-HCAL < 5-PTBL < 5-PACK †	0	3.00+0.18+1.00 INC. WITH TEXT 8.00+0.48+2.00
6800	EZMERPS	ECHO 1, ZERO MEMORY, ECHO REVERSE & PRINT SUBROUTINES BY HOWARD BERENBON-INTERFACE AGE, OCT. 1976, VOL.1, #11.	6-PTAL < 6-TEXT < 6-HCAL < 6-PACK †	0	5.00+0.30+1.00 1.00+0.06+1.00 INC. WITH TEXT
8080	ESP-1	ESP-1 SOFTWARE PACKAGE BY MICHAEL SHRAYER-INTERFACE AGE, OCT. 1976, VOL.1, #11. PTGR IS PAPER TAPE COPY OF GRAMMAR.	7-PTOD < 7-MAN < 7-CTOD < 7-MAN < 7-PTGR < 7-HCAL < 7-PACK †	< 0	30.00+1.80+1.50 INC. WITH PTOD 30.00+1.80+1.50 INC. WITH CTOD 5.00+0.30+1.50 INC. WITH PTGR
8080	PTSP-1	PROCESSOR TECHNOLOGY SOFTWARE PACKAGE NO. 1 SUMMARY BY R. A. STEVENS-INTERFACE AGE, OCT. 1976, VOL.1, #11.	8-PTGR < 8-TEXT < 8-PACK †	< 0	5.00+0.30+1.50 INC. WITH PTTL
8080	ERAMMT	EXHAUSTIVE 8080 RAM MEMORY TEST PROGRAM BY T.E. TRAVIS-INTERFACE AGE, NOV. 1976, VOL.1, #12.	9-PTAL < 9-PTOD < 9-TEXT < 9-HCAL < 9-HCOD < 9-PACK †	0	6.00+0.36+2.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH TEXT
6800	MEMDMP-1	SWTPC 6800 MEMORY DUMP PROGRAM MEMDMP-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	10-PTAL < 10-PTSL < 10-PTOD < 10-TEXT < 10-HCAL < 10-PACK †	0	5.00+0.30+1.00 8.00+0.48+1.00 INC. WITH PTSL 1.00+0.06+1.00 INC. WITH TEXT
6800	ROBIT-1	SWTPC 6800 ROTATING BIT RAM MEMORY DIAGNOSTIC	11-PTAL < 11-PTSL < 0	0	5.00+0.30+1.00 8.00+0.48+1.00

	PROGRAM ROBIT-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	11-PTOD < 1.00+0.06+1.00 11-TEXT < INC. WITH TEXT 11-HCAL < INC. WITH TEXT 11-PACK +	INC. WITH PTSL 1.00+0.06+1.00 INC. WITH TEXT	OF ASSEMBLY PROGRAM LISTINGS OF PARTS 2,3, & 4.			
6800	MEMCON-1 SWTPC 6800 SHORT MEMORY ADDRESS CONVERGENCE PROGRAM MEMCON-1 BY GARY KAY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	12-PTAL < 0 5.00+0.30+1.00 12-PTSL < 0 8.00+0.48+1.00 12-PTOD < INC. WITH PTSL 12-TEXT < 1.00+0.06+1.00 12-HCAL < INC. WITH TEXT 12-PACK +		SC/MP NIBL NIBL-NATIONAL'S TINY BASIC GRAMMAR FOR SC/MP BY PHIL ROYBAL - INTERFACE AGE, DEC. 1976, VOL.2, #1. ASSEMBLY LISTING PUBLISHED JAN. 1977, VOL.2, #1.	29-TEXT < 0 5.00+0.30+2.00 29-HCAL < 10.00+3.00+2.00 29-PTSL < 10.00+3.00+2.00 29-PTOD < 5.00+0.30+1.00 29-PTGR < 2.00+0.12+1.00 29-PACK +		
6800	BJIB BLACKJACK IN BASIC PROGRAM BY ED KEITH & DENNIS HESCOX. THE BJIB PAPER TAPE OBJECT CODE REQUIRES ROBERT UITERVYK'S SWTPC MICROBASIC OPERATING SYSTEM-INTERFACE AGE, NOV. 1976, VOL.1, #12. PTBL INCLUDES SAMPLE RUN, INSTRUCTIONS, LIST OF VARIABLES AND LIST OF ROUTINES.	13-PTBL < 0 9.00+0.54+2.00 13-PTBL+ < 12.00+0.72+2.00 13-TEXT < 2.00+0.12+1.00 13-HCAL < INC. WITH TEXT 13-PACK +		SC/MP MVBAGELS BAGELS BY DR. MARVIN WINZINREAD BY PERMISSION & COURTESY OF NATIONAL SEMICONDUCTOR - INTERFACE AGE, DEC. 1976, VOL.2, #1.	30-PTBL < 0 5.00+0.30+2.00		
				8080 AMSR0 AMSAT 8080 STANDARD DEBUG MONITOR BY RICHARD C ALLEN & JOE KASSER - BYTE # 13, SEPT. 1976, VOL.2, #1. SUBMITTED BY JOE KASSER.	31-PTSL < 2 15.00+0.90+2.00 31-PTOD < 5.00+0.30+2.00 31-PACK +		
				6800 BAFCMP BASIC ALGORITHMS FOR COMMON MATH FUNCTIONS BY MICHAEL P. BURTON -	32-PTBL < 1 6.00+0.36+1.00 32-TEXT < 2.00+0.12+1.00 32-PACK +		
6502	RFRP REVISED FLOATING POINT ROUTINES FOR 6502* BY ROY RANKIN & STEVE WOZNIAK - INTERFACE AGE, NOV. 1976, VOL.1, #12. NOTE * - ORIGINAL MATH PACKAGE FIRST APPEARED IN DR. DOBB'S JOURNAL, AUG. 1976, VOL.1, #7.	14-PTOD < 1 5.00+0.30+1.00 14-PTAL < 9.00+0.54+2.00 14-PTSL < 10.00+0.60+2.00 14-TEXT < 2.00+0.12+1.00 14-HCAL < INC. WITH TEXT 14-PACK +		8080 ECMSO MICROCOMPUTER STOCK OPTIONS BY EDWARD CHRISTIANSON - INTERFACE AGE, FEB. 1977, VOL.2, #3.	33-PTBL < 0 15.00+0.90+2.00 33-HCBLF < 5.00+0.30+2.00 33-HCBLF+ < INC. WITH PTBL 33-TEXT < 5.00+0.30+2.00 33-PACK +		
6800	HISPDMP HIGH SPEED DOUBLE PRECISION MULTIPLICATION SUBROUTINE-HISPDMP BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	15-PTAL < 0 8.00+0.48+1.00 15-TEXT < 1.00+0.06+1.00 15-HCAL < INC. WITH TEXT 15-PACK +		8080 BMRNG RANDOM NUMBER GENERATOR BY BOB MARTIN - INTERFACE AGE, FEB. 1977, VOL.2, #3.	34-PTAL < 0 7.00+0.42+2.00 34-PTSL < 6.00+0.36+2.00 34-TEXT < 2.00+0.12+1.00 34-HCALF < 4.00+0.24+1.00 34-HCALF+ < INC. WITH PTAL 34-PACK +		
6800	DIV16 REENTRANT 16 BIT DIVIDE SUBROUTINE - DIV16 BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	16-PTAL < 1 8.00+0.48+1.00 16-TEXT < 1.00+0.06+1.00 16-HCAL < INC. WITH TEXT 16-PACK +		8080 RNDFGCST RND FUNCTION GENERATOR CHI-SQUARE TEST PROGRAM BY BOB MARTIN - INTERFACE AGE, FEB. 1977, VOL.2, #3.	35-PTBL < 4.00+0.24+1.00 35-HCBLF+ < INC. WITH PTBL 35-PACK +		
6800	RENTMUP REENTRANT DOUBLE PRECISION MULTIPLICATION SUBROUTINE-RENTMUP BY PERMISSION AND COURTESY OF MOTOROLA'S M6800 USER GROUP LIBRARY-INTERFACE AGE, NOV. 1976, VOL.1, #12.	17-PTAL < 0 8.00+0.48+1.00 17-TEXT < 1.00+0.06+1.00 17-HCAL < INC. WITH TEXT 17-PACK +		8080 TTMOCRS 8080 MEMORY OBJECT CODE SEARCH ROUTINE BY T. E. TRAVIS - INTERFACE AGE, FEB. 1977, VOL.2, #3.	36-PTAL < 0 5.00+0.30+1.00 36-PTSL < 5.00+0.30+1.00 36-TEXT < 1.00+0.06+1.00 36-HCALF+ < INC. WITH TEXT 36-HCALF < 2.00+0.12+1.00 36-PACK +		
8080	HOMEK COMPUTER OR CONTROLLER BY TERRY BENSON, INTEL - INTERFACE AGE, SEPT. 1976, VOL.1, #10.	18-PTAL < 0 5.00+0.30+1.00 18-PTSL < 5.00+0.30+1.00 18-TEXT < 1.00+0.06+1.00 18-HCAL < INC. WITH TEXT 18-PACK +		8080 TDOMP 8080 OCTAL MONITOR PROGRAM BY THOMAS E. DOYLE	37-PTAL < 0 8.00+0.48+2.00 37-PTSL < 8.00+0.48+2.00 37-TEXT < 2.00+0.12+1.00 37-HCALF < 4.00+0.24+1.00 37-HCALF+ < INC. WITH PTAL 37-PTOD < 5.00+0.30+1.50 37-PACK +		
8080	LCST STARKTEK BY LYNN COCHRAN-INTERFACE AGE, JUNE 1976, VOL.1, #7.	19-PTBL < 0 7.00+0.42+1.00 19-TEXT < 3.00+0.18+1.00 19-HCAL < INC. WITH TEXT 19-PACK +		8080 LLLBFPM LLLBASIC FLOATING POINT MATH PACKAGE BY DAVID MEAD & MODIFIED BY HAL BRAND AND FRANK OLKEN - INTERFACE AGE, FEB. 1977, VOL.2, #3.	38-TEXT < 0 3.00+0.18+2.00 38-HCALF+ < 5.00+0.30+2.00 38-PTSL < 36.00+2.16+4.00 38-PACK +		
8080	WSPG WORD SEARCH PUZZLE GENERATOR BY RICHARD S. EDELMAN - INTERFACE AGE, JULY 1976, VOL.1, #8.	20-PTBL < 0 6.00+0.36+1.00 20-TEXT < 2.00+0.12+1.00 20-HCAL < INC. WITH TEXT 20-PACK +		8080 Z80MERP Z80 MITS 12K EXTENDED BASIC PATCHES BY MARTIN D. GRAY - INTERFACE AGE, MARCH 1977, VOL.2, #4.	39-TEXT < 0 1.00+0.06+1.00 39-HCALF+ < 1.00+0.06+1.00 39-PACK +		
8080	PGBIORHY BIORHYTHM BY PAUL GREEN - INTERFACE AGE, AUG. 1976, VOL.1, #9.	21-PTBL < 0 6.00+0.36+1.00 21-TEXT < 1.00+0.12+1.00 21-HCAL < INC. WITH PTBL 21-PACK +		6502 RJBAST 6502 APPLE STAR-TREK BY ROBERT J. BISHOP	40-TEXT < 0 3.00+0.18+1.00 40-HCAL < INC. WITH TEXT 40-PACK +		
8080	WDBIORHY BIORHYTHMS IN PRACTICE BY WILLIAM L. DONNAN, M.D. - INTERFACE AGE, AUG. 1976, VOL.1, #9.	22-PTBL < 0 8.00+0.48+2.00 22-TEXT < 2.00+0.12+1.00 22-HCAL < INC. WITH TEXT 22-PACK +		6800 AMIPROTO AMI'S PROTO DEVELOPMENT SOFTWARE FOR EVK SERIES PROTOTYPING BOARDS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A. STEVENS-INTERFACE AGE, FEB. 1977, VOL.2, #3.	41-TEXT < 0 3.00+0.18+1.00 41-HCALF+ < 5.00+0.30+2.00 41-PACK +		
8080	REBJ BLACKJACK BY RICHARD S. EDELMAN - INTERFACE AGE, AUG. 1976, VOL.1, #9.	23-PTBL < 0 6.00+0.36+1.00 23-TEXT < 1.00+0.06+1.00 23-HCAL < INC. WITH TEXT 23-PACK +		8080 CONSOL CONSOL IX RESIDENT OPERATING SYSTEM BY PERMISSION AND COURTESY OF PROCESSOR TECHNOLOGY-INTERFACE AGE, JAN. 1977, VOL.2, #2.	42-TEXT < 0 3.00+0.18+1.00 42-HCALF+ < 5.00+0.30+2.00 42-PACK +		
8080	BLUFF BLUFF BY PHIL FELDMAN & TOM RUGE - INTERFACE AGE, SEPT. 1976, VOL.1, #10.	24-PTBL < 0 6.00+0.36+1.00 24-TEXT < 1.00+0.06+1.00 24-HCAL < INC. WITH TEXT 24-PACK +		8080 ODT-80 LLL BASIC OCTAL DEBUGGING PROGRAM BY E. R. FISHER-INTERFACE AGE, MARCH 1977, VOL.2, #4.	43-TEXT < 0 3.00+0.18+2.00 43-HCALF+ < 5.00+0.30+2.00 43-PACK +		
6800	RABSIMB RELATIVE ADDRESS BACK-STEPPER IN MICRO-BASIC BY J. HUFFMAN - INTERFACE AGE, DEC. 1976, VOL.1, #13.	25-PTBL < 0 5.00+0.30+1.00 25-HCAL < 1.00+0.06+1.00 25-TEXT < INC. WITH HCBL 25-PACK +		6800 (RS)+3 RESIDENT 6800 REENTRANT SELF-RELATIVE SUBROUTINE PACKAGE FOR EVK 6800 MICROCOMPUTER BOARDS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A. STEVENS	44-TEXT < 0 3.00+0.18+1.00 44-HCALF+ < 5.00+0.30+2.00 44-PACK +		
6800	TEFT6800 TEXT EDITOR FOR THE SWTPC-6800 BY MARK BORGESON - INTERFACE AGE, DEC. 1976, VOL.1, #13. HCAL IS COPY OF FULL SIZE ASSEMBLY LISTING.	26-PTAL < 0 15.00+0.90+2.00 26-PTOD < 10.00+0.60+2.00 26-HCAL < 3.00+0.18+1.50 26-TEXT < 2.00+0.12+1.25 26-PACK +		8080 EXMON 6800 MIKBUG EXTENDED MONITOR SYSTEM BY MICHAEL BURTON - INTERFACE AGE, APRIL 1977, VOL.2, #5.	45-TEXT < 0 2.00+0.12+1.00 45-HCALF+ < 5.00+0.30+2.00 45-PTAL < 9.00+0.54+2.00 45-PTOD < 5.00+0.30+2.00 45-PACK +		
8080	WPATBX WANG'S PALO ALTO TINY BASIC BY ROGER RAUSKOLB - INTERFACE AGE, DEC. 1976, VOL.1, #13. HCAL & HCBL ARE COPIES OF FULL SIZE CODE	27-PTSL < 0 20.00+1.20+3.00 27-PTOD < 10.00+0.60+2.00 27-HCAL < 4.00+0.24+1.50 27-TEXT < INC. WITH HCAL 27-HCAL < 4.00+0.24+1.50 27-PACK +		8080 LMCOS 8080 CASSETTE OPERATING SYSTEM (COS) BY LORIN MOHLER-INTERFACE AGE, APRIL 1977, VOL.2, #5.	46-TEXT < 3.00+0.18+1.00 46-PTSL < 10.00+0.60+2.00 46-HCALF+ < 5.00+0.30+2.00 46-PACK +		
8080	LLLBI LLL 8080 BASIC INTERPRETER GRAMMAR BY JERRY BARBER & ROYCE ECKARD - SUBMITTED BY E.R. FISHER - INTERFACE AGE, DEC. 1976, VOL.2, #1(PART 1). JAN. 1977, VOL.2, #2(PART 2). FEB. 1977, VOL.2, #3(PART 3). MARCH 1977, VOL.2, #4(PART 4). TEXT1 IS PART 1, TEXT2 IS PART 2, ETC. HCAL2,3, & 4 ARE FULL SIZE XEROX COPIES	28-TEXT1 < 0 5.00+0.30+2.00 28-PTSL2 < 57.00+3.42+6.00 28-HCAL2 < 5.00+0.30+2.00 28-TEXT2 < 3.00+0.18+2.00 28-PTSL3 < 36.00+2.16+4.00 28-HCAL3 < 5.00+0.30+2.00 28-TEXT3 < 3.00+0.18+2.00 28-PTSL4 < 15.00+0.90+2.00 28-TEXT4 < 3.00+0.18+2.00 28-HCAL4 < 3.00+0.18+2.00 28-PACK +		6800 MHFTIHFC MOTOROLA 6800 HEX FORMAT TO INTEL FORMAT SOFTWARE CONVERTER BY FLOYD NORDIN	47-TEXT < 0 1.00+0.06+1.00 47-PTAL < 5.00+0.30+2.00 47-PTSL < 5.00+0.30+2.00 47-PTOD < 3.00+0.18+1.00 47-HCALF+ < 3.00+0.18+1.00 47-HCALF < INC. WITH HCAL 47-PACK +		

SOFTWARE SECTION

SOFTWARE EDITORIAL

8080	MMGTFC	GRAPHICS- THE EASY WAY BY MARKIN MALLON- INTERFACE AGE, MARCH 1977, VOL.2, #4.	48-TEXT 0 48-HCBLF	3.00+0.18+1.00 5.00+0.30+1.00	DUMP PROGRAM BY ALAN R. MILLER	56-PTSL < 56-PTOD < 56-HCAL < 56-HCAL < 56-HCSL < 56-HCSL < 56-PACK +	8.00+0.48+2.00 5.00+0.30+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	CRMS	RYTEMOVER SOFTWARE FOR THE CROMEMCO 8K BYTESAVER BOARD - PERMISSION AND COURTESY OF CROMEMCO EDITED BY JOE EDLSON- INTERFACE AGE, JAN. 1977, VOL.2, #2.	49-TEXT 0 49-HCAL	5.00+0.30+1.00 INC. WITH TEXT			
8080/	FNOCDA	8080/280 OBJECT CODE DIS-ASSEMBLER BY FLOYD L. NORDIN- STANDARD VERSION HANDLES UP TO 1K LABLES & ASSIGNS SYMBOLIC NAMES. ASCII CHARACTER LIST PIN POINTS EMBEDDED TABLES. INCLUDES BOTH ASSEMBLY AND SOURCE OUTPUT MODES VIA YOUR OUTPUT DRIVERS. PROGRAM RESIDES AT TOP OF MEMORY. STANDARD VERSIONS AVAILABLE FOR 16K, 24K, 32K, 48K AND 64K BYTES OF MEMORY. OTHER VERSIONS WITH ADDITIONAL LABLE SPACE AND/OR DIFFERENT MEMORY SIZE ARE AVAILABLE.	50-PTOD < 20 50-MAN < 50-PACK +	40.00+2.40+2.00 5.00+0.30+1.00 45.00+2.70+3.00			
6800	SWTPMB	SWTP'S 6800 MICROBASIC VER. 1.4 BY ROBERT H. UITERWYK AND BY PERMISSION & COURTESY OF SOUTHWEST TECHNICAL PRODUCTS CORP. SWTPC 6800 COMPUTER NEWSLETTER #1, JUNE 1976.	51-PTOD 0	15.00+0.90+2.00			
6800	EVMKB	SWTP'S 6800 MICROBASIC VER. 1.4 MODIFIED FOR AMI'S 6800 EVK MICROCOMPUTER BOARDS BY STEVEN D. WALL.	52-PTOD 0	15.00+0.90+2.00			
8080	CCOKEN	ARTIFICIAL INTELLIGENCE TIC-TAC-TOE PROGRAM (OR MENACE OF THE MICROWORLD) BY KEN BERKUM -INTERFACE AGE, MARCH 1977, VOL.2, #4.	53-PTBL < 0 53-TEXT < 53-HCBL < 53-HCBL < 53-PACK +	10.00+0.60+2.00 2.00+0.12+1.00 INC. WITH PTBL 2.00+0.12+1.00			
6800	JHDOTWP	DAY OF THE WEEK PROGRAM BY JIM HUFFMAN.	54-PTBL < 0 54-TEXT < 54-HCBL < 54-HCBL < 54-PACK +	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH PTBL 1.00+0.06+1.00			
6800	JHCBBP	CHECKBOOK BALANCER PROGRAM BY JIM HUFFMAN	55-PTBL < 0 55-TEXT < 55-HCBL < 55-HCBL < 55-PACK +	6.00+0.36+1.00 1.00+0.06+1.00 INC. WITH PTBL 1.00+0.06+1.00			
8080	HEXDUMP	INTEL HEX FORMAT PAPER TAPE	56-PTAL < 1	8.00+0.48+2.00			
8080	CONVERT1	NUMBER BASE CONVERSION- NON DISC VERSION BY JOHN W. SWAIN				57-PTBL < 0 57-TEXT < 57-HCBL < 57-HCBL < 57-PACK +	7.00+0.42+1.00 2.00+0.12+1.00 INC. WITH PTBL 1.00+0.06+1.00
8080	CONVERT2	NUMBER BASE CONVERSION- DISC BASED VERSION OF CONVERT1 ABOVE BY JOHN W. SWAIN				58-PTBL < 0 58-TEXT < 58-HCBL < 58-HCBL < 58-PACK +	7.00+0.42+1.00 2.00+0.12+1.00 INC. WITH PTBL 1.00+0.06+1.00
Z80	SERIAL	USER TTY HANDLER FOR THE Z80 DEVELOPMENT SYSTEM BY RICHARD E. MALY				59-TEXT 0 59-HCAL < 59-PTOD < 59-PTAL < 59-PTSL < 59-PACK +	3.00+0.18+1.00 2.00+0.12+1.00 10.00+0.60+2.00 INC. WITH PTOD INC. WITH PTOD
6800	MEMTEST	A BETTER 6800 MEMORY TEST BY ED KEITH				60-PTAL < 0 60-PTSL < 60-PTOD < 60-TEXT < 60-HCAL < 60-HCAL < 60-HCSL < 60-HCSL < 60-PACK +	8.00+0.48+2.00 8.00+0.48+2.00 3.00+0.18+1.00 2.00+0.12+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	AMLIFE	JOHN CONWAY'S GAME OF LIFE PROGRAMMED BY ALAN R. MILLER				61-PTAL < 4 61-PTSL < 61-PTOD < 61-TEXT < 61-HCAL < 61-HCAL < 61-HCSL < 61-HCSL < 61-PACK +	15.00+0.90+2.00 10.00+0.60+2.00 5.00+0.30+1.00 2.00+0.12+1.00 INC. WITH PTAL 2.00+0.12+1.00 INC. WITH PTSL 2.00+0.12+1.00
8080	SFSL	STAR LANES PROGRAM BY STEVEN FABER				62-PTBL < 0 62-HCBL < 62-TEXT < 62-HCBL < 62-HCBL < 62-PACK +	15.00+0.90+2.00 2.00+0.12+1.00 2.00+0.12+1.00 INC. WITH PTBL 2.00+0.12+1.00
8080	HDSS	SHOOTING STARS TBX PROGRAM BY HERMAN DEMONSTOY -				63-PTBL < 0 63-HCBL < 63-TEXT <	10.00+0.60+2.00 2.00+0.12+1.00 2.00+0.12+1.00
8080	PAYROLL	PAYROLL PROGRAM IN BASIC BY BUD SHAMBURGER - INTERFACE AGE, JUNE 1977, VOL.2, #7.				64-PTBL < 0 64-HCBL < 64-TEXT < 64-PACK +	20.00+1.20+2.00 5.00+0.30+2.00 2.00+0.12+1.00
8080	TCOS	D&M'S TAPE CASSETTE SOFTWARE OPERATING SYSTEM FOR THE 8080 MICROCOMPUTER -SUMMARY BY R.A. STEVENS - INCLUDES 8080 ASSEMBLER + LINE TEXT EDITOR + MONITOR - TAPE FORMAT IS DON TARBELL'S OR PROCESSOR TECHNOLOGY'S CUTS STANDARD. INTERFACE AGE, JULY 1977, VOL.2, #8.				65-CTOD < 0 65-MAN <	30.00+1.80+2.00 5.00+0.30+1.00
8080	PTOS	D&M'S PAPER TAPE SOFTWARE OPERATING SYSTEM FOR THE 8080 MICROCOMPUTER-SUMMARY BY R.A. STEVENS -SAME AS TCOS #65-CTXX BUT FOR ASR 33 TTY I/O SYSTEM- INTERFACE AGE, JULY 1977, VOL.2, #8.				66-PTOD < 0 66-MAN <	30.00+1.80+2.00 5.00+0.30+1.00
8080	DOSE	D&M'S DISC SOFTWARE OPERATING SYSTEM EXTENSION FOR THE NORTH STAR 8080 FLOPPY DISC OPERATING SYSTEM - SUMMARY BY R.A. STEVENS - ADDS TCOS/PTOS FUNCTIONS TO PROVIDE FULL OPERATING SYSTEM CAPABILITIES TO THE LIMITED NORTH STAR FLOPPY DISC SOFTWARE OPERATING SYSTEM. PROGRAM MEDIA IS A NORTH STAR FLOPPY DISC.- INTERFACE AGE, JULY 1977, VOL.2, #8.				67-FDOD < 0 67-MAN <	60.00+3.60+3.00 5.00+0.30+1.00
SC/MP	SSEIKOPP	SC/MP SEIKO PRINTER INTERFACE AND PROGRAM BY PHILIP ROYBAL - INTERFACE AGE, MAY 1977, VOL.2, #6.				68-PTSL < 0 68-PTOD < 68-HCSL < 68-HCDD < 68-TEXT < 68-PACK +	15.00+0.90+2.00
Z80	RASST	Z80 SUPER STAR TREK MODIFIED BY ROGER AMIDON. RUNS ON TDL'S Z80 8K BASIC				69-PTBL < 0 69-HCBL < 69-PACK +	10.00+0.60+2.00 2.00+0.12+1.00
8080	DODR	DIABLO OUTPUT DRIVER ROUTINE BY CHRIS TARRY - INTERFACE AGE, JULY 1977, VOL.2, #8.				70-PTOD < 0 70-PTSL < 70-PTAL < 70-TEXT < 70-PACK +	15.00+0.90+2.00
6800	IOTST	6800 PIA I/O TEST PROGRAM BY WILLIAM C. WRARY OF MOTOROLA & PERMISSION AND COURTESY OF MOTOROLA'S 6800 USER GROUP LIBRARY - INTERFACE AGE, JULY 1977, VOL.2, #8.				71-PTOD < 0 71-PTSL < 71-TEXT < 71-HCDD < 71-HCSL < 71-PACK +	7.00+0.42+1.50 10.00+0.60+2.00 INC. WITH PTSL 2.00+0.12+1.00 3.00+0.18+1.00
8080	TICTAC	TIC TAC TOE GAME IN BASIC BY BUD SHAMBURGER				72-PTBL	7.00+0.42+2.00
8080	BOWL	BOWL GAME IN BASIC BY BUD SHAMBURGER - INTERFACE AGE, JULY 1977, VOL.2, #8.				73-PTBL	7.00+0.42+2.00

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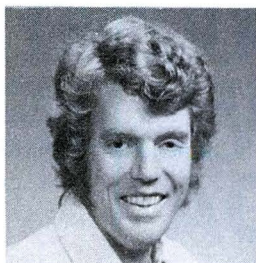
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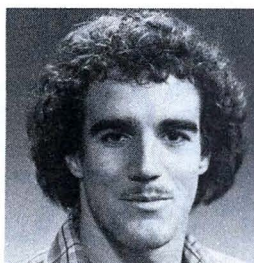
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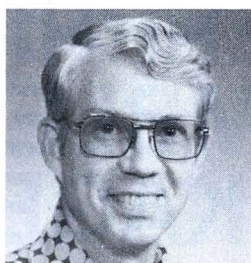
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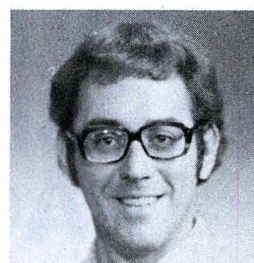
Michael Eusey



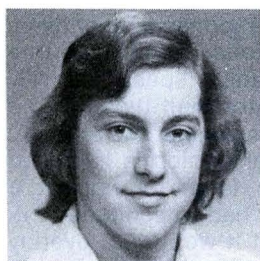
Paul Tripe



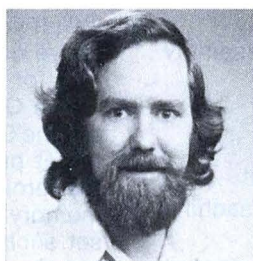
John Trotter



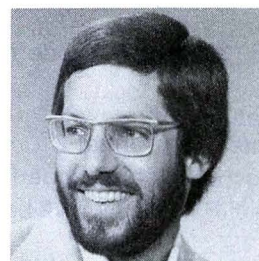
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SUMMARY OF NORDIN ENTERPRISES 8080/Z80 DISASSEMBLER SOFTWARE PACKAGE FNOCDA

Reviewed by Robert A. Stevens

FEATURES

- Dis-assembles 8080 & Z80 object code into assembly source code.
- Object code available on
 - paper tape in Intel HEX format
 - iCOM floppy disc in machine code format
 - Cassette type in PT's 300 or 12-baud machine code format
 - Cassette tape in Don Tarbell machine code format
- Occupies 8K of memory
- Computer directed cue prompting
 - Print source code!
 - Print ASCII assembly dump!
 - Start address, finish address offset address = !
- Object code offset addressing
- Assembly listing and/or dump output
- Source listing and/or dump output (punch output)
- Up to 1K of symbol names (labels)
- Label table assignment listing
- Uncovers ASCII tables and messages imbedded in program
- Provide means to locate and uncover binary imbedded tables
- Dis-assembler program is completely self contained and automatic except for the console input/output drivers

DIS-ASSEMBLER OPERATION

It is loaded into RAM memory along with a target program. Both are resident in RAM, the Dis-assembler occupying high memory and the target program — low memory. For reference see Figure 1, Memory Map of Disassembler.

Execution of the Dis-assembler begins by a jump to its start address.

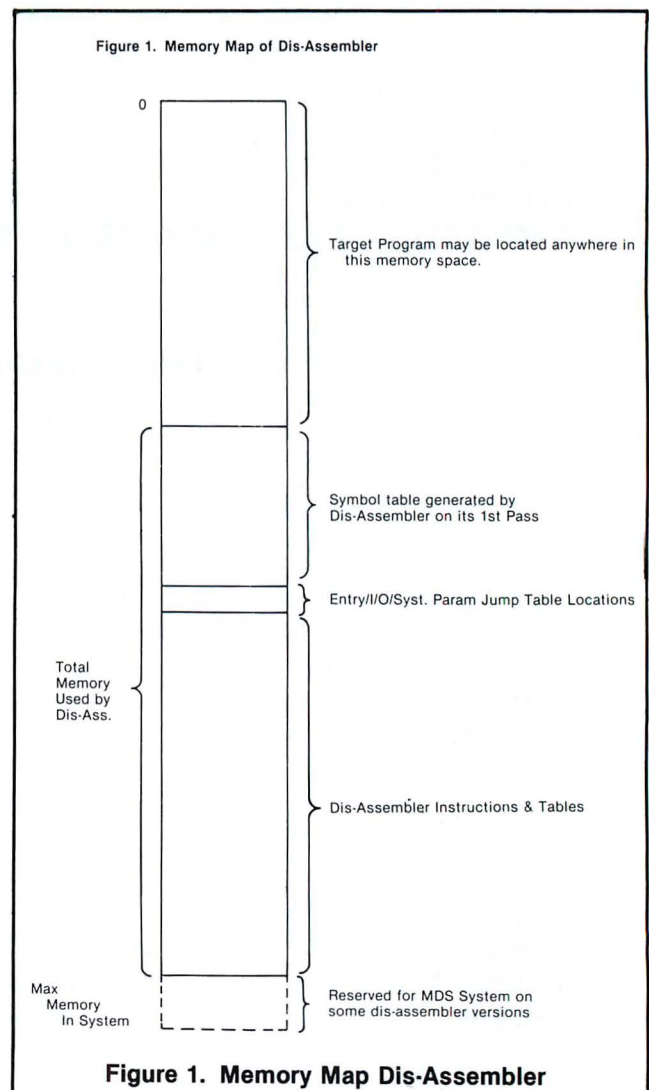
It prints on the console device three questions that require answers:

- Punch the source? (Y or any Char.)
- Print ASCII dump? (Y or any Char.)
- Start Addr. Finish Addr. Offset =

If you have a *separate* punch device and wish to punch out the source code part of the Dis-assembler listing you would answer the 1st question with "Y". The program immediately types out the second question. If you wish to precede your listing with an ASCII dump, type

"Y"; if your response is negative to either or both of the above questions — just type in any character besides "Y", for instance "space" or "N".

The Operator then types in the HEX characters that tell the Dis-assembler the start and finish address of the target program which is in memory. The offset is -0- if the program is in its normal executing location of memory. If it had to be loaded into memory with an offset such that it would not overlay the memory used by



ENTRY//O System Parameter Definitions

Addr	Object Code	Description
S.A.	C3 YY XX	JMP Start ; Go to beginning of program
S.A. + 3	C3 <u>03 F8</u>	JMP CI ; Console input driver S.A. - returns with a new ASCII Char in "A" Reg.
S.A. + 6	C3 <u>09 F8</u>	JMP CO ; Console output driver S.A. - expects an ASCII Char in "C" Reg. & returns without destroying it.
S.A. + 9	C3 <u>0F F8</u>	JMP LO ; List output driver S.A. - same requirements as "CO".
S.A. + 12	C3 <u>00 F8</u>	JMP MNTR ; Location to Jump to when <i>Dis</i> - ; Assy program is finished.
S.A. + 15	C3 <u>0C F8</u>	JMP PO ; Punch output Driver S.A. - same requirements as "CO" could be patched to be Com Floppy "Write a Char" (E821H)
S.A. + 18	C3 (SA + 12)	JMP MNTR ; Update entry - can be used when ; "PO" is I Com Floppy under "Run Go" ; CMND - this would be patched ; To Jump to I Com's Firmware ; "Update" entry point (E836H)
S.A. ± 21	<u>HH GG</u>	STACK ADDR ; location of Dis-Assy stack
S.A. + 23	<u>JI</u>	Table Size Parameter
S.A. + 24	<u>KK JJ</u>	Symbol Table start addr.

(1) The standard automatic dis-assembler program supplied assumes an MDS host system.

(2) Underlined locations would be those most likely to be patched by user.

Figure 2. For Automatic Dis-Assembler

the Dis-assembler, then that same offset value is entered so that the Dis-assembler will print out a correct listing. The start, finish, and offset numbers entered are separated by commas and ended with a CR. Any number of digits may be entered for each address. The program accepts one digit if that is all, or the *last* four digits entered for each value (start, finish, offset) in case a mistake is made in one of the digits entered.

The *Dis-Assy* program first builds a symbol table. The standard program will allow up to 1023 labels — plenty for even the largest programs. (The *Dis-Assy* program's limit is 12K labels.) It produces a label for any jump type of code whose following address lies within the start and finish values previously entered.

The *Dis-Assy* program then prints out a listing which substitutes the labels anywhere they are valid. As a subroutine start label or as the operand of a jump, LXI, call, or jump on condition OP code. All OP codes are printed

in their assembly language mnemonic form. The listing, when finished, looks like the output of an assembler printout, however, without the comments. It should be noted that any HEX printout is preceded by a "zero" and ended with an "H". This is mainly for the benefit of the punched source output. This way a punched source may be edited with a minimum of difficulty. As a minimum the punched source would require inserting an "ORG" statement at the front and an "End" statement at the end. If there are any (A) imbedded tables or (B) out of range (between start and finish) addresses that need changes or (C) other discrepancies found, then these will require editing also. Once this has been done, however, the source code may be assembled with an 8080 assembles program to produce a new object tape. The purpose of this process usually is to locate a program that you have in object code only into a new location.

If one suspects there are ASCII tables or messages

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imbedded in the program, their location and content may be uncovered. The program will first print out an ASCII dump between the start and finish addresses entered, then it will proceed to do the dis-assembly with its printout. The ASCII dump looks at each memory location and if it finds a printable ASCII Char code there it prints it. Otherwise it prints a period. Its format is 64 locations per line with the HEX address printed for each line.

Binary tables are a little more difficult to uncover. However, with some experience an operator may learn to pick them out with relative ease.

At the conclusion of the disassembly printout it prints the complete symbol table including symbol name, its address, and the number of times it is called or used in the program.

The Dis-assembler program is self contained for all functions except the console input/output drivers. If your 8080 based system is different than the Intel MDS system that this program was designed to run on, then you must provide these input/output drivers somewhere in memory and then patch the *Dis-Assy* program with the appropriate start addresses. An explanation of the jump table is shown in Figure 2. If you do not have a separate list device (printer) then the console out and list out addresses would be the same. If you do not have a place to jump after using the *Dis-Assy* program, then the monitor (MNTR) address could be patched with the start address of the *Dis-Assy* program such that it would try to begin again.

FNOCDA STANDARD CONFIGURATIONS

FNOCDA is assembled for five standard memory locations which are shown in Table 1.

Table 1. For Automatic *Dis-Assy* Program

8080 Syst Memory Size	Dis-Assy Start Addr	Dis-Assy Occupies Memory:	A Program to be Dis-Assembled may occupy any location in memory;(*)
16K	2C00H	2000H-3EC0H	0-1FFFFH
24K	3C00H	3000H-4EC0H	0-2FFFFH
32K	6C00H	6000H-7EC0H	0-5FFFFH
48K	AC00H	A000H-BEC0H	0-9FFFFH
64K	E400H	D800H-F7C0H	0-D7FFFH

*The Dis-Assembler can dis-assemble itself — therefore in reality the total memory space available can be included.

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D & M 8080 SOFTWARE OPERATING SYSTEM

Reviewed by Robert A. Stevens

The D&M 8080 software operating system consists of a 14-command monitor line editor and a 2-pass, 256-label, 9-error flagged, 4-pseudo-OP directive assembler. This software operating system is available in the following three configurations:

TCOS	Tape Cassette Operating System — Don Tarbell or CUTS tape format
PTOS	Paper Tape Operating System — Intel Hex or D&M's binary format
DOSE	Disc Operating System Extension — Adds full operating system capabilities to the limited North Star floppy disc system

FEATURES

- 14 COMMANDS
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- UP TO 256 SYMBOLS
- COMPLEX EXPRESSIONS
- ALL REGISTERS PREDEFINED
- AUTO LINE NUMBERING
- SYMBOL TABLE IS PRINTED W/ASSEMBLY LISTING
- RUNS IN LOW MEMORY
- NO RESTART INTERFERENCE (CAN BE INTERRUPT DRIVEN)
- RUNS IN 6K INCLUDING SYMBOL TABLE (MEMORY AVAILABLE TO USER = 1800H +)
- TRANSLATES LOWER CASE CHARACTERS TO UPPER CASE

COMMANDS

ESC	Restart input and terminate list
ENTR	Enter Hex from memory
DUMP	Read Hex from memory
FILE	Open, Delete, or Assign file areas
ASEM(E,S)	Assemble current file (Error software switch, Symbol software switch)
LIST	List current file to console
DELT	Delete lines from current file
PAGE	Move 256 bytes of memory
SAVE	Save a file on tape or disc
LOAD	Load file from tape
LINE	Set line numbers
LABL	List symbol table
CTRL C	Clear VDM (on VDM version)
CTRL S	Set speed (on VDM version)

ASSEMBLER

The Assembler is a two pass assembler which is invoked by the ASEM command. Once invoked the assembler begins operating on the active file in RAM memory.

The assembler reads source code (pseudo OPs, Labels, OP codes), from a source file which has been entered in RAM memory by the operator using the line editor. During pass one, the source file is scanned for the purpose of generating relative addresses and building a symbol table. During pass two, the source file is read again and translated line for line into binary matching object code. This code is stored in the object file.

Assembler Predefined Labels — Predefined labels are used to indicate the 8080 hardware registers and can only be used as labels (names) for these registers. These predefined labels are:

A	= Accumulator
B	= B Register or BC Register Pair
C	= C Register
D	= D Register or DE Register Pair
E	= E Register
H	= H Register or HL Register Pair
L	= L Register
M	= Memory (via HL Register Pair)
S	= Stack Pointer Register
P	= Processor Status Word
\$	= Location Counter

Assembler Errors — Errors are detected by the assembler and displayed on the console to aid source program debugging. The following error codes are included:

O	= Opcode Error
D	= Duplicate Label Error
V	= Value Error
S	= Syntax Error
A	= Argument Error
L	= Label Error
M	= Missing Label Error
U	= Undefined Label
R	= Register Error

Errors are flagged in the extreme left column of the listing. If that column is blank, no errors occurred during assembly.

Assembler Directives — Special opcoded assembler directives (or pseudo OPs) that tell the assembler what values to equate to labels and where and how to assemble code are included. These are

DB	= Define Byte
----	---------------

SOFTWARE SECTION

DW = Define Word
DS = Define Storage
ORG = Assemble source code starting at specified address

EDITING

Text lines are entered into an open file by typing a four digit line number in the range of 0000 to 9999 followed with text. The line number must be four digits long, and can be entered automatically using the line command.

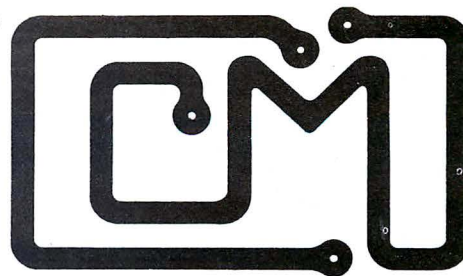
The lines are sorted into the RAM file area numerically as in BASIC, and the file area expands and contracts as is required. A line may be corrected by typing the number of the line to be corrected and the new line itself. No provision is made for correcting single characters in a line.

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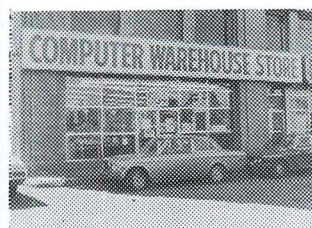


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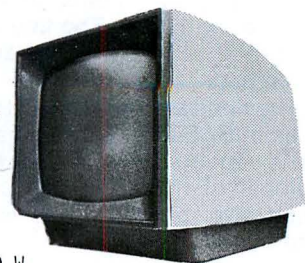


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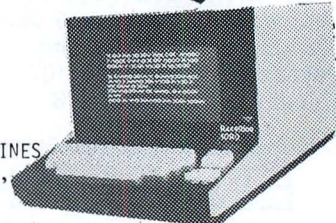


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8080 INTEL HEX FORMAT PAPER-TAPE PUNCH PROGRAM — HEXDUMP

by Alan R. Miller

INTRODUCTION

The October 1976 issue of *INTERFACE AGE* presented a program for loading and verifying paper tapes punched in the Intel HEX checksum format for the 8080 microprocessor. Here is a program that can be used to punch tapes in that format. A block of memory is dumped as a series of records, each starting with an ASCII colon (3A HEX) and followed by ASCII-encoded characters. These characters are respectively the record length (2 characters), the load address of the record (4 characters), the record type (00), the data and the checksum (the negative of the sum of all other bytes in the record). A *carriage return, line feed* and *nulls* are followed by another colon signaling the start of the next record. *End of file* is indicated by a record length of *zero*.

This format produces tapes that are twice as long as those punched in binary since it requires two HEX characters to represent each byte of memory, but for short programs such as the one presented here, this is not a problem. The advantage of this format is that all of the possible byte values (0 to 255) will print in human-readable form when the resulting tape is run through a teletype tape reader.

RUNNING HEX DUMP

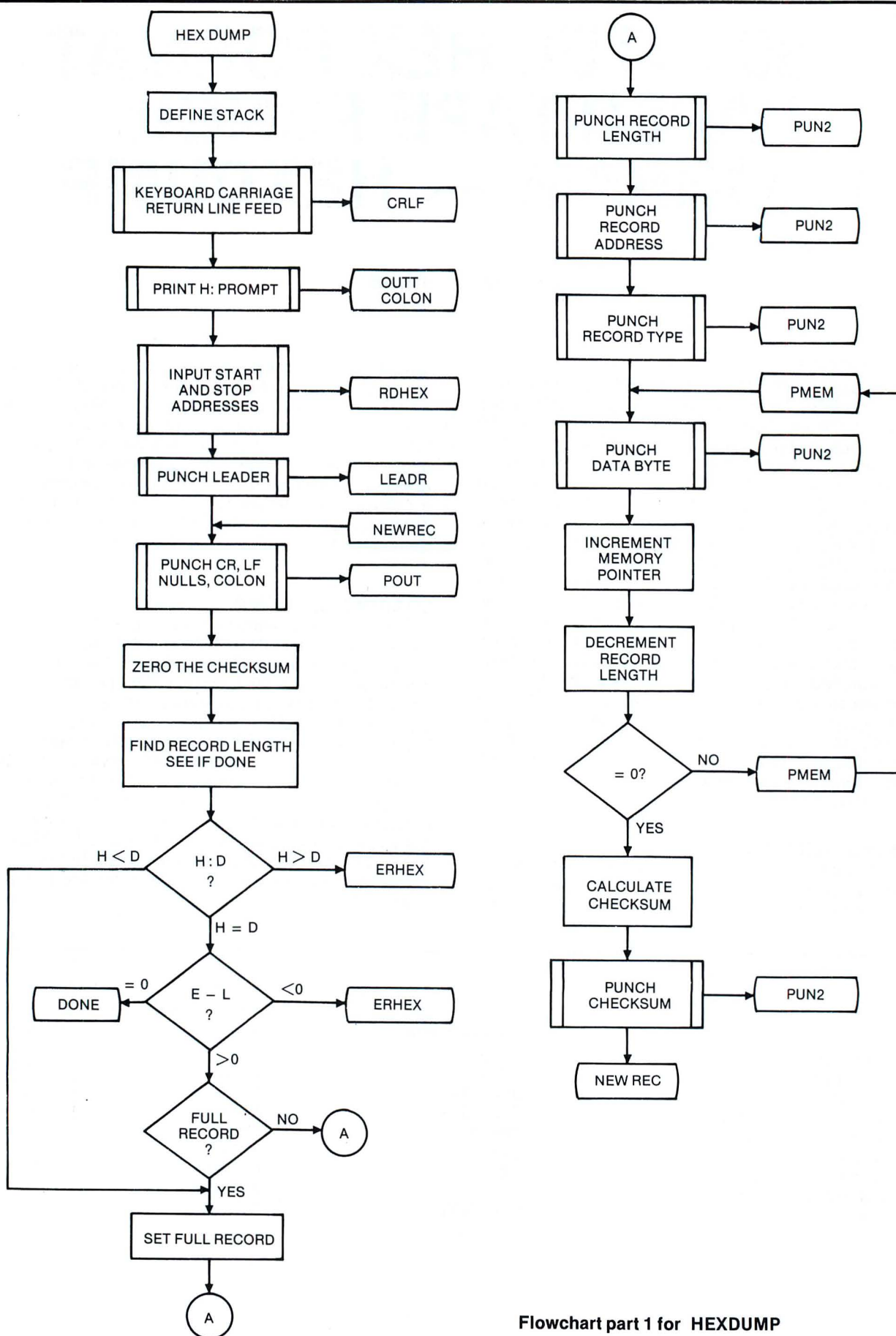
Start the program at the beginning and a prompt of "H:" will appear at the keyboard. Type in the start address (two HEX characters for the high and two for the

low). Another colon will appear as a prompt for the *stop* address. Enter the four HEX characters of the *stop* address and the program will start punching the tape, including a blank header and trailer. Another prompt of "H:" will then appear as the program is ready to punch another tape. If a mistake is made when entering the addresses, type a *Control-C* to restart the program. Typing a *Control-X* will return to your monitor. If an improper character is typed (not 0-9, A-f, *Control-C* or *Control-X*) a question mark is printed and the program is restarted.

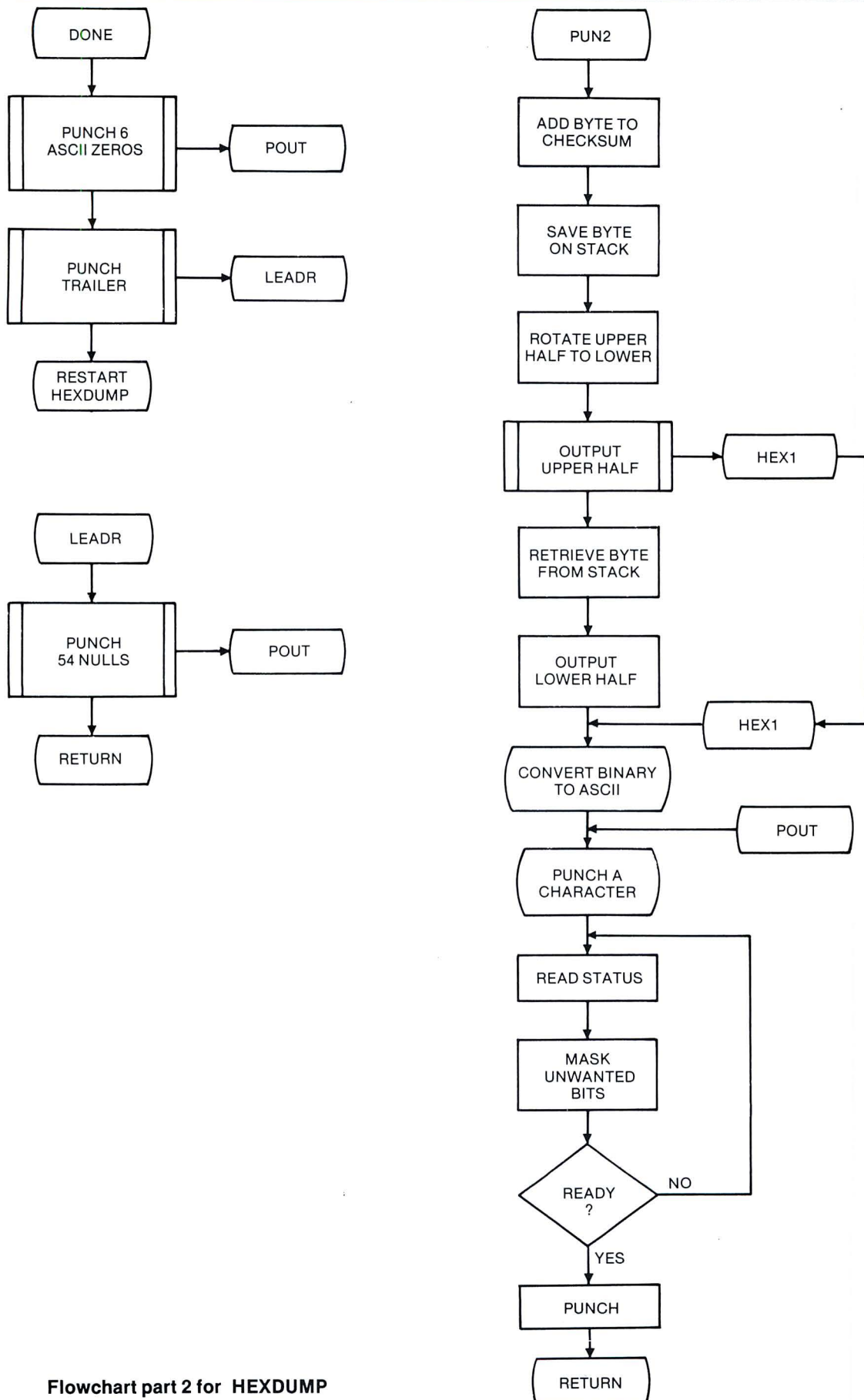
LOADING HEXDUMP

The HEX checksummed object program, which can be loaded with the *INTERFACE AGE* HEX loader, is assembled for the address range 5000-512D HEX. The program is written for a main terminal at address 10/11 HEX and a separate punch at address 12/13 HEX. The program can be readily changed to accommodate a combination keyboard-punch (e.g. an ASR teletype) at the same address. The data-available mask is 01 and the transmit-buffer-empty mask is 02. The stack, which is located at the end of the program, must be placed elsewhere if it is desired to protect the memory the program is in or if the program is to be placed in PROM. Six levels (12 bytes) of stack are needed. The following table gives the locations and values of parameters that may need to be changed.

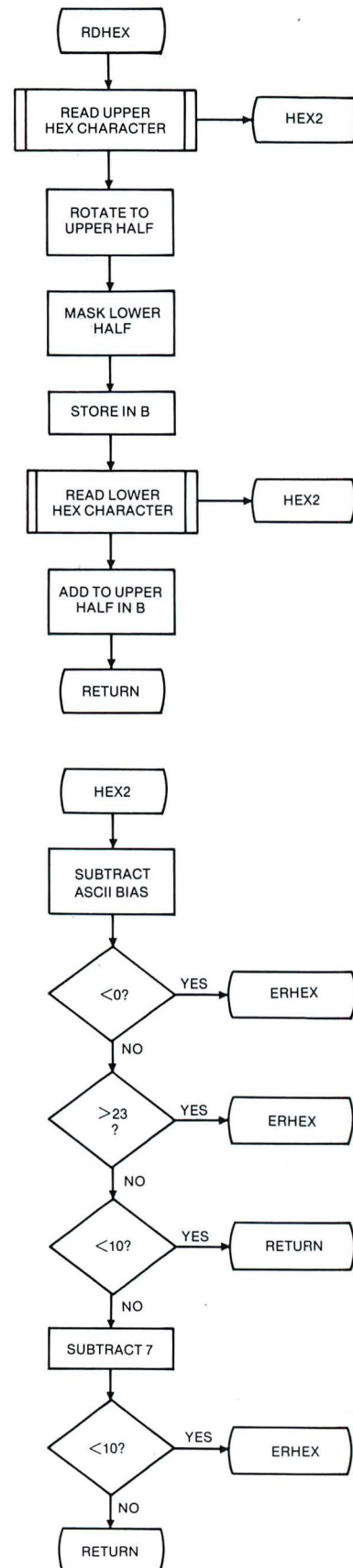
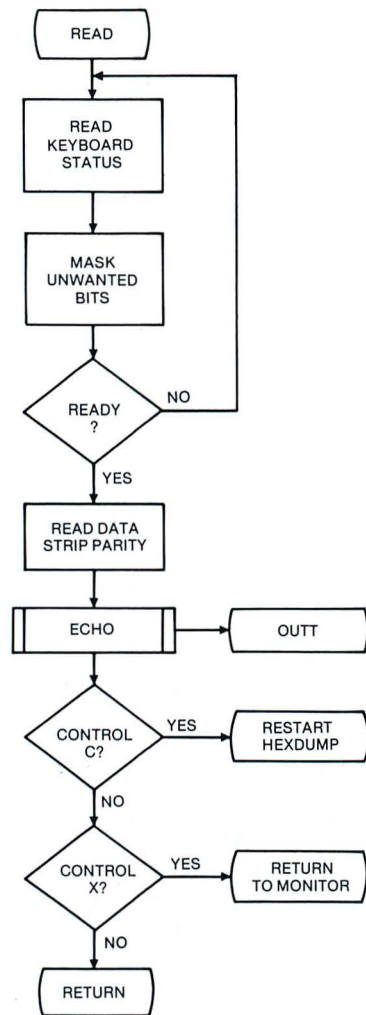
	Address (HEX)	Source Program Variable	Data (HEX)
Define stack	5001,2	STACK	0000
Return on Control-X	5009,A	RETURN	0000
Record length	504E, 5053	RLEN	10
Keyboard status address	50B4, 50F8	TYSTAT	10
Keyboard data address	50BB, 5100	TYDATA	11
Punch status address	50A9	PSTAT	12
Punch data address	50B1	PDATA	13
Mask for data available	50B6	INMASK	01
Mask for transmit-buffer empty	50AB, 50FA	OUTMSK	02
Jump (not) zero	50AC, 50B7, 50FB		CA



Flowchart part 1 for HEXDUMP



Flowchart part 2 for HEXDUMP



Flowchart part 3 for HEXDUMP

HEXDUMP ASSEMBLY PROGRAM LISTING

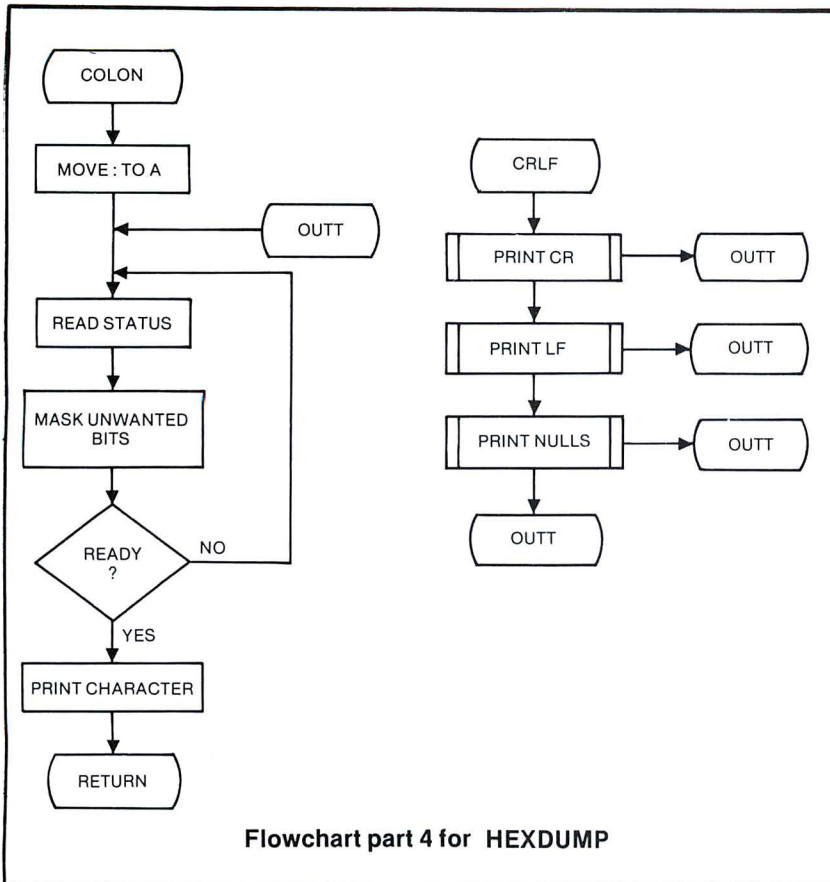
```

1  ;HEXDUMP: A PROGRAM TO PUNCH INTEL HEX CHECKSUM
2  ;      TAPES,      FEBRUARY 22, 1977
3  ;
4  ;PROGRAMMED FOR AN 8080 MICROPROCESSOR.
5  ;BY ALAN R. MILLER
6  ;NEW MEXICO TECH, SOCORRO, NM 87801
7  ;
8  ;
9  ;REQUIRES 302 BYTES INCLUDING STACK SPACE
10 ;ASSUMES KEYBOARD IS ADDRESSED TO 10/11H
11 ;AND PUNCH TO 12/13H. BOTH MAY BE SET TO
12 ;ANOTHER (OR THE SAME) ADDRESS BY CHANGING
13 ;THE EQUATES FOR TYSTAT, TYDATA, PSTAT,
14 ;AND PDATA
15 ;WHEN STARTED AT "START", THE PROGRAM PRINTS
16 ;AN "H:" AS A PROMPT. USER THEN
17 ;ENTERS START AND STOP ADDRESS
18 ; (MOST SIGNIFICANT BYTE FIRST)
19 ;
20 ;
21 ;EQUATES
22 ;
23 RETURN EQU 0 ;RETURN TO MONITOR
24 ; ON CONTROL-X
25 RLEN EQU 16 ;RECORD LENGTH
26 TYSTAT EQU 10H ;KEYBOARD STATUS ADDR.
27 TYDATA EQU 11H ;KEYBOARD DATA ADDRESS
28 PSTAT EQU 12H ;PUNCH STATUS ADDRESS
29 PDATA EQU 13H ;PUNCH DATA ADDRESS
30 OUTMSK EQU 2 ;OUTPUT MASK
31 INMSK EQU 1 ;INPUT MASK
32 CR EQU 0DH ;CARRAGE RETURN
33 LF EQU 0AH ;LINE FEED
34 ;
35 ;

```

BRANCH TO PAGE 156

Flowchart part 4 for HEXDUMP



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7410	.20	74153	.90	74LS11	.38	74LS192	2.40	8212 INTERRUPT	14.00	INTEL	SBC 80/10
7411	.20	74154	1.10	74LS13	1.00	74LS193	2.40	8214 CLOCK CHIP	6.00		Prototype Pack 1100.00
7413	1.00*	74155	1.40	74LS20	.40	74LS194	2.00	8224 EROM	10.00	INTEL	SBC 80/20
7420	.24	74156	1.10	74LS21	.40	74LS195	1.45	8238/8228 EROM	14.00		Prototype Pack 1700.00
7421	.45	74157	1.10	74LS30	.40	74LS251	2.10	C1702 EROM	14.00	INTEL	SYS 80/10 1500.00
7430	.25	74160	1.30	74LS32	.42	74LS253	2.10	S5204 EROM	33.00	INTEL	SBC 80/10
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7495	.80	74H119	1.50					8T97/74LS367	1.25		
7496	1.00	74H120	1.50					75367 ECL to TTL	1.00		
74100	1.05	9601	1.25								
74121	.40	9602	1.10								
74122	.50										

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```

37 5003 312051 START: LXI SP,STACK
38 5003 C0A51 CALL CRLF
39 5006 3E48 MVI A,"H" ;PRINT H FOR
40 5008 CDF650 CALL OUTT ; A PROMPT
41 500E CDF450 CALL COLON
42 5011 60 RDHEX ;START ADDRESS (HIGH)
43 5012 CDCC50 MOV H,B
44 5015 68 RDHEX ;START ADDRESS (LOW)
45 5016 68 MOV L,B
46 5019 CDCC50 CALL COLON
47 501C 50 RDHEX ;STOP ADDRESS (HIGH)
48 501D CDCC50 MOV D,B
49 5020 58 RDHEX ;STOP ADDRESS (LOW)
50 5021 13 MOV E,B
51 5022 CD8750 INX D
52 CALL LEADR ;PUNCH LEADER
53 ;START A NEW RECORD, ZERO THE CHECKSUM
54 ;PUNCH CR, LF, 2 NULLS AND A COLON
55 ;
56 5025 3E0D NEWREC: MVI A,CR
57 5027 CDA750 CALL POUT ;PUNCH CARRIAGE RETURN
58 502A 3E0A MVI A,LF
59 502C CDA750 CALL POUT ;PUNCH LINE FEED
60 502F AF XRA A
61 5030 CDA750 CALL POUT ;PUNCH 2 NULLS
62 5033 CDA750 CALL POUT
63 5036 3E3A MVI A,"*"
64 5038 CDA750 CALL POUT ;PUNCH A COLON
65 503B 0600 MVI B,0 ;ZERO THE CHECKSUM
66 ;
67 ;FIND RECORD LENGTH
68 ;
69 503D 7C MOV A,H ;COMPARE HIGH POINTER
70 503E BA CMP D ;TO HIGH STOP
71 503F DA5250 JC R16 ;H < D, FULL RECORD
72 5042 C20251 JNZ ERHEX ;ERROR, H > D, QUIT
73 5045 7B MOV A,E ;H = D
74 5046 95 SUB L ;COMPARE LOW POINTER
75 ;TO LOW STOP
76 5047 CA7650 JZ DONE ;L = E, FINISHED
77 504A DA0251 JC ERHEX ;ERROR, H = D, L > E
78 504D FE10 CPI RLEN
79 504F DA5450 JC NEW2 ;SHORT RECORD
80 5052 3E10 R16: MVI A,RLEN ;FULL LENGTH
81 5054 AF NEW2: MOV C,A ;PUT RECORD LENGTH IN C
82 5055 CD9250 CALL PUN2 ;PUNCH RECORD LENGTH
83 5058 7C MOV A,H
84 5059 CD9250 CALL PUN2 ;PUNCH ADDRESS (HIGH)
85 505C 7D MOV A,L
86 505D CD9250 CALL PUN2 ;PUNCH ADDRESS (LOW)
87 5060 AF XRA A
88 5061 CD9250 CALL PUN2 ;PUNCH RECORD TYPE (00)
89 5064 7E PMEM: MOV A,M
90 5065 CD9250 CALL PUN2 ;PUNCH MEMORY BYTE
91 5068 23 INX H ;INCR. MEMORY POINTER
92 5069 0D DCR C ;DECR. RECORD LENGTH
93 506A C26450 JNZ PMEM
94 506D 78 MOV A,B
95 506E 2F CMA
96 506F 3C INR A ;CALCULATE CHECKSUM
97 5070 CD9250 CALL PUN2 ;PUNCH CHECKSUM
98 5073 C32550 JMP NEWREC
99 ;
100 ;FINISHED, PUNCH 6 ZEROS FOR LAST RECORD
101 ;
102 5076 3E30 DONE: MVI A,30H ;ASCII ZERO
103 5078 0606 MVI B,6
104 507A CDA750 P6Z: CALL POUT ;PUNCH A ZERO
105 507D 05 DCR B
106 507E C27A50 JNZ P6Z
107 5081 CD8750 CALL LEADR ;PUNCH TRAILER
108 5084 C30050 JMP START ;NEXT DUMP
109 ;
110 ;SUBROUTINE TO PUNCH BLANK HEADER AND TRAILER
111 ;
112 5087 AF LEADR: XRA A
113 5088 0636 MVI B,54 ;NUMBER OF TAPE NULLS
114 508A CDA750 NLDL: CALL POUT
115 508D 05 DCR B
116 508E C28A50 JNZ NLDL
117 5091 C9 RET
118 ;
119 ;SUBROUTINE TO PUNCH TWO HEX CHARACTERS
120 ;FROM A BYTE
121 ;
122 5092 F5 PUN2: PUSH PSW
123 5093 80 ADD B ;ADD TO CHECKSUM
124 5094 47 MOV B,A
125 5095 F1 POP PSW
126 5096 F5 PUSH PSW
127 5097 1F RAR ;ROTATE UPPER CHARACTER
128 5098 1F RAR
129 5099 1F RAR ;TO LOWER
130 509A 1F RAR
131 509B CD9F50 CALL HEX1 ;OUTPUT UPPER CHARACTER
132 509E F1 POP PSW ;OUTPUT LOWER CHARACTER
133 ;
134 ;SUBROUTINE TO PUNCH A HEX CHARACTER
135 ;FROM THE LOWER FOUR BITS
136 ;
137 509F E60F HEX1: ANI 0FH ;MASK UPPER 4 BITS
138 50A1 C690 ADI 90H
139 50A3 27 DAA ;INTEL DAA TRICK
140 50A4 C340 ACI 40H
141 50A6 27 DAA ;ONCE AGAIN
142 ;
143 ;SUBROUTINE TO PUNCH A CHARACTER
144 ;
145 50A7 F5 POUT: PUSH PSW
146 50A8 DB12 POUTW: IN PSTAT ;CHECK STATUS
147 50AA E602 ANI OUTMSK
148 50AC CAA850 JZ POUTW ;LOOP IF NOT READY
149 50AF F1 POP PSW
150 50B0 D313 OUT PDATA
151 50B2 C9 RET
152 ;
153 ;SUBROUTINE TO INPUT A BYTE FROM THE KEYBOARD
154 ;
155 50B3 DB10 READ: IN TYSTAT ;CHECK STATUS
156 50B5 E601 ANI INMASK
157 50B7 CAB350 JZ READ ;LOOP IF NOT READY
5003 50B8 DB11 READ2: IN TYDATA
5003 50B8 E67F ANI 7FH ;STRIP PARITY
5003 50BE CDF650 CALL OUTT ;ECHO
5003 50C1 FE03 CPI 3 ;RESTART ON
5003 50C3 CA0050 JZ START ;CONTROL-C
5003 50C6 FE18 CPI 18H ;RETURN ON
5003 50C8 CA0000 JZ RETURN ;CONTROL-X
5003 50CB C9 RET
5003 ;
5003 ;SUBROUTINE TO INPUT TWO HEX CHARACTERS TO B
5003 RDHEX: CALL HEX2 ;READ UPPER CHARACTER
5003 50CC CDCC50 RLC ;ROTATE TO UPPER HALF
5003 50CF 07 RLC
5003 50D0 07 RLC
5003 50D1 07 RLC
5003 50D2 07 RLC
5003 50D3 E6F0 ANI 0F0H ;MASK LOWER 4 BITS
5003 50D5 47 MOV B,A ;STORE IN B
5003 50D6 CDCC50 CALL HEX2 ;READ LOWER CHARACTER
5003 50D9 80 ADD B ;COMBINE BOTH CHAR.
5003 50DA 47 MOV B,A ;STORE THEM IN B
5003 50DB C9 RET
5003 ;
5003 ;SUBROUTINE TO INPUT A HEX CHARACTER TO A
5003 ;
5003 HEX2: CALL READ
5003 50DF D630 SUI "0" ;SUBTRACT ASCII BIAS
5003 50E1 DA0251 JC ERHEX ;ERROR, LESS THAN "0"
5003 50E4 FE17 CPI 23
5003 50E6 D20251 JNC ERHEX ;ERROR, > THAN "F"
5003 50E9 FE0A CPI 10
5003 50EB 05 RC ;NUMBER IS 0-9
5003 50EC D607 SUI 7
5003 50EE FE0A CPI 10
5003 50F0 DA0251 JC ERHEX ;ERROR, BETWEEN "9"-"A"
5003 50F3 C9 RET ;CHARACTER IS A-F
5003 ;
5003 COLON: MVI A,":" ;OUTPUT A COLON
5003 ;TO THE KEYBOARD
5003 ;
5003 ;SUBROUTINE TO OUTPUT A CHAR. TO THE KEYBOARD
5003 ;
5003 OUTT: PUSH PSW
5003 50F7 DB10 WAITO: IN TYSTAT ;CHECK STATUS
5003 50F9 E602 ANI OUTMSK
5003 50FB CAF750 JZ WAITO ;LOOP IF NOT READY
5003 50FE F1 POP PSW
5003 50FF D311 OUT TYDATA
5003 5101 C9 RET
5003 ;
5003 ;OUTPUT A ? TO INDICATE IMPROPER INPUT
5003 ;
5003 ERHEX: MVI A,"?"
5003 5104 CDF650 CALL OUTT
5003 5107 C30050 JMP START
5003 ;
5003 ;CARRIAGE RETURN, LINE FEED FOR KEYBOARD
5003 ;
5003 CRLF: MVI A,CR ;CARRIAGE RETURN
5003 510C CDF650 CALL OUTT
5003 510F 3E0A MVI A,LF ;LINE FEED
5003 5111 CDF650 CALL OUTT
5003 5114 AF XRA A
5003 5115 CDF650 CALL OUTT ;FOUR NULLS
5003 5118 CDF650 CALL OUTT
5003 511B CDF650 CALL OUTT
5003 511E C3F650 JMP OUTT
5003 ;
5003 ;
5003 DS 12 ;SPACE FOR STACK
5003 DS 1
5003 BEG START
5003 END IXH
5003 RUN IXH
5003 EOA

```

HEXDUMP OBJECT PROGRAM DUMP

```

:10500000312D51CD0A513E48CDF650CDF450CDC8C6
:105010005060CDCC5068CDF450CDCC5050CDCC505C
:105020005813CD87503E0DCDA7503E0ACDA75050AFA7
:105030005C4750CDA7503E3ACDA75006007CBADA96
:105040005250C202517B95CA7650DA0251FE10DAF4
:1050500054503E104FCDD92507CCD92507DCD925009
:10506000AFCD92507ECD9250230DC26450782F3C2C
:10507000CD9250C325503E300606CDA75005C27ACA
:1050800050CD8750C30050AF0636CDA75005C28A19
:1050900050C9F5800747F1F51F1F1F1F1FCD9F50F1E646
:1050A0000FC69027CE4027F5DB12E602CAA850F1C2
:1050B000D313C9DB10E601CAB350DB11E6750DF68E
:1050C00050FE03CA005050F18CA0000C9CDDC5007CC
:1050D000070707E6F047CDDC508047C9CDB350D66F
:1050E00030DA0251FE17D20251FE0AD80607FE0A64
:1050F000DA0251C93E45F5DB10E602CAF750F1D3A5
:1051000011C93E3CDF650C300503E0DCDF650C3E86
:105110000ACDF650AFCDF650CDF650CDF650C3F6D1
:0E512000500000000000000000000000000000031
:0000000

```


A BETTER 6800 MEMORY TEST—MEMTEST

by Ed Keith

The one thing your system relies on most is its memory. If you bought the memory assembled and tested you should be able to count on it without any worry as to its condition. But if you assembled it yourself, you must test it *yourself* and this means you will need a good memory test program.

The simplest test program is one which begins at an address and loads a bit pattern of 01 which is then read back to see if it was stored correctly. If not, an error line is written showing the address and the stored and read patterns. If the pattern is correctly stored and read the pattern is shifted to the left one bit giving 02 and the test retried. If all goes well, patterns 04, 08, 10, 20, 40 and 80 are applied to the address under test exercising each bit in the byte. The test then moves on and repeats the iteration for each byte in the segment being tested. This is the logic used in ROBIT-1 which can be found in the November 1976 issue of INTERFACE AGE Magazine. This approach tests each bit in an addressed area of memory, but can miss a fault on the memory board!

When you assembled that 4K memory board you soldered over 512 tiny pins on 32 ICs. In many cases the PC board traces run directly between the pins you were soldering. It is not inconceivable that a little splash of solder could bridge two of those traces and cause a problem, which the previously mentioned memory test would NOT discover. Here's the problem: With such a solder bridge, one location in memory could be responding to several addresses. Ideally, a different, unique memory location will respond to every different address that the microprocessor puts on the memory bus. But, if your memory lines are shorted because of a solder bridge or if a bad chip has an internal short then some of the locations in your memory may be responding to several addresses. When your microprocessor places an address on the address bus it expects the correct location to respond. But, when a memory location responds the microprocessor has no way of knowing that the responding memory location was the correct one. Imagine yourself typing questions to be passed under a door to four of your friends in the next room. You address the question to a particular friend by typing his name on the question. You receive a typed answer pushed under the door. Which of your friends answered the question? The one to whom you addressed it, or another? This should help you to understand why a simple test such as ROBIT-1 can indicate that a memory board is good when it is not.

There are several ways to circumvent the problem mentioned above. One involves sending out zeros to the complete range of addresses you wish to test. Then sending a pattern to one of them and testing all the rest for a change then shifting the pattern as in ROBIT-1 and repeating the check to see if any other address shows a non-zero condition. This test will find any address line shorts but takes a long while to run. A second approach is simpler to program and runs somewhat faster.

In this program I have broken the test into two phases. First there is a memory load phase and second a test phase. In Phase One the program works its way up in memory storing decimal numbers in memory; 00 in the first location, 01 in the second, ..., 10 in the ninth, etc., up to the one-hundredth location which gets 99. The one-hundred and first location gets 00 again and the pattern repeats to the end of the memory under test. Phase Two involves starting at the first location and looking for a 00 then a 01 in the second and so on until the test is complete, at which time the beginning pattern is incremented by one and the test restarted. Any shorted address lines will show up since the 00 to 99 pattern will be broken. The difference between what is stored and what should be there will give you a clue to the problem. If only one error occurs per pass through memory then most likely you have one bad chip. This you can confirm by using the memory change function of MIKBUG on the indicated location. If however, sequential addresses show an error and the difference between what is there and what should be there is constant then you probably have an address line short and should examine your memory board. Remove all the chips from your board (if you didn't use sockets, this step may take a while) and check for a short. If you do not find one you may have a chip with an internal short. Insert each chip one at a time and retest for a short after each insertion.

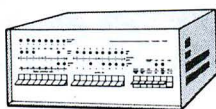
The program I present here has been written to reside in the 128-byte scratch-pad RAM on a 6800 system and uses several routines in MIKBUG for output. The addresses of the ends of the memory block to be tested are also loaded in the scratch-pad RAM. The low address should be loaded into A002 and A003, the upper address into A004 and A005. The address counter at A048 is set to A073 and the program started.

You can enter the program into your system a byte at a time using the memory modification feature of MIKBUG. Begin at line 490 in the program entering the instructions and stopping after the F0 of line 690. There is a gap here that is used for the program stack area. The program begins again with address A048 at line 740 and ends with a 97 in A07C at line 1070. If you don't want to enter the program by hand you can obtain an object tape in Motorola punch format from the Microcomputer Software Depository.

The program itself utilizes all of the space available in the scratch-pad RAM except for two areas. The first, a data storage area which extends from address A000 to A013 and the second, the program stack area which extends from A037 to A047. The data storage area is used by the routines in MIKBUG as a work space and is partitioned as follows:

ADDRESS	USED FOR	NAME
A000-A001	Interrupt Request Address Vector	IOV

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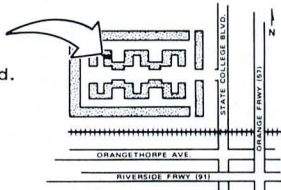
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A002-A003	Beginning Address for Punch	BEGA
A004-A005	Ending Address for Punch	ENDA
A006-A007	Non-maskable Interrupt Address Vector	NIO
A008-A009	Stack Pointer Save Area	SP
A00A	Check Sum Area	CKSM
A00B	Byte Count Area	BYTECT
A00C-A00D	Index Register Save Area	XHI-XLOW
A00E	Character Count Area	TEMP
A00F-A010	Address Temporary Area	TW
A011	Frame Count	MCONT
A012-A013	Alternate Index Register Save Area	XTEMP

Not all of the common MIKBUG routines use all of these areas. If you are looking for a convenient area for some of your program data, particularly for inter-program communication, some of these may be available. Most of the routines use the A register so its contents are volatile but only one of the routines which make use of the B register does *not* save and restore it.

The common routines with the areas and registers they affect are found in the following table:

ROUTINE	USES	EXIT METHOD
BADDR	BYTE A00A, A00C-D, A012-3, AR, BR	RTS
BYTE	INHEX A00A, A012-3	RTS
OUTHL	AR	JMP OUTEEE

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1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
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2N3055	NPN	15A	60v	.50
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4001	.20	7401	.15	7474	.35	74180	.85	74H101	.75	74S140	.75
4002	.20	7402	.20	7475	.35	74181	2.75	74H103	.75	74S151	.35
4004	3.95	7403	.20	7476	.30	74182	.95	74H106	.95	74S153	.35
4006	1.20	7404	.15	7480	.55	74190	1.75			74S157	.80
4007	.35	7405	.25	7481	.75	74191	1.35			74S158	.35
4008	1.20	7406	.35	7483	.95	74192	1.65	74L00	.35	74S194	1.05
4009	.30	7407	.55	7485	.95	74193	.85	74L02	.35	74S257(8123)	.25
4010	.45	7408	.25	7486	.30	74194	1.25	74L03	.30		
4011	.20	7409	.15	7489	1.35	74195	.95	74L04	.35		
4012	.20	7410	.10	7490	.55	74196	1.25	74L10	.35	74LS00	.45
4013	.40	7411	.25	7491	.95	74197	1.25	74L20	.35	74LS01	.45
4014	1.10	7412	.30	7492	.95	74198	2.35	74L30	.45	74LS02	.45
4015	.95	7413	.45	7493	.40	74221	1.00	74L47	1.95	74LS04	.45
4016	.35	7414	1.10	7494	1.25	74367	.85	74L51	.45	74LS05	.55
4017	1.10	7416	.25	7495	.60			74L55	.65	74LS08	.45
4018	1.10	7417	.40	7496	.80			74L72	.45	74LS09	.45
4019	.70	7420	.15			75108A	.35	74L73	.40	74LS10	.45
4020	.85	7426	.30			75110	.35	74L74	.45	74LS11	.45
4021	1.35	7427	.45	74100	1.85	75491	.50	74L75	.55	74LS20	.40
4022	.95	7430	.15	74107	.35	75492	.50	74L93	.55	74LS21	.25
4023	.25	7432	.30	74121	.35			74L123	.55	74LS22	.25
4024	.75	7437	.35	74122	.55					74LS32	.40
4025	.35	7438	.35	74123	.55	74H00	.25			74LS37	.40
4026	1.95	7440	.25	74125	.45	74H01	.25	74S00	.55	74LS40	.55
4027	.50	7441	1.15	74126	.35	74H04	.25	74S02	.55	74LS42	1.75
4028	.95	7442	.55	74132	1.35	74H05	.25	74S03	.40	74LS51	.65
4030	.35	7443	.85	74141	1.00	74H08	.35	74S04	.35	74LS74	.75
4033	1.95	7444	.45	74150	1.00	74H10	.35	74S05	.35	74LS86	.75
4034	2.45	7445	.80	74151	.75	74H11	.25	74S08	.35	74LS90	1.30
4035	1.25	7446	.95	74153	.95	74H15	.30	74S10	.35	74LS93	1.00
4040	1.35	7447	.95	74154	1.05	74H20	.30	74S11	.35	74LS107	.95
4041	.69	7448	.95	74156	1.15	74H21	.25	74S20	.35	74LS123	1.00
4042	.95	7450	.25	74157	.65	74H22	.40	74S40	.25	74LS151	.75
4043	1.25	7451	.25	74161	.85	74H30	.25	74S50	.25	74LS153	1.20
4044	.95	7453	.20	74163	.95	74H40	.25	74S51	.45	74LS157	.85
4046	1.50	7454	.25	74164	.60	74H50	.25	74S64	.25	74LS164	1.90
4049	.80	7460	.40	74165	1.50	74H51	.25	74S74	.40	74LS367	.85
4050	.60	7470	.45	74166	1.35	74H52	.15	74S112	.90	74LS368	.70
4066	1.35	7472	.45	74175	.80	74H53J	.25	74S114	1.30		
4069	.40					74H55	.25				
4071	.35										
4082	.45										

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9301	.85
9309	.35
9322	.85
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9601	.75
9602	.50

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1702A	7.95
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MM5316	3.50
2102-1	1.75
2102L-1	1.95
TMS6011NC	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

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8266	.35	LM320K5 (7905)	1.65	LM340T-24	.95	LM723	.50
8836	.95	LM320K12	1.65	LM340K-12	2.15	LM725	1.75
MCT2	.95	LM320T12	1.25	LM340K-15	1.25	LM739	1.50
8038	3.95	LM320T15	1.65	LM340K-18	1.25	LM741 8-14	.20
LM201	.75	LM339	.95	LM340K-24	.95	LM747	1.10
LM301	.25	7805 (340T-5)	.95	LM373	2.95	LM1307	1.25
LM308 (Mini)	.75	LM340T-12	1.00	LM380	.95	LM1458	.95
LM309H	.65	LM340T-15	1.00	LM709(8,14 PIN)	.25	LM3900	.50
LM309K(340K-5)	.85	LM340T-18	1.00	LM711	.45	LM75451	.65
LM310	1.15					NE555	.50
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LM318 (Mini)	.65					NE565	.95
						NE566	1.75
						NE567	1.35
						SN72720	1.35
						SN72820	1.35

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```

OUTHR  AR                      JMP OUTEEE
OUTCH  A012-3                 JMP OUTEEE
INCH   A012-3                 JMP INEEE
PDATA1 OUTCH                  RTS
      A012-3, AR
INHEX  INCH                   RTS
      AR
OUT2H  OUTHL                   BRA OUTHR
      AR
OUT4HS OUT2H                   BRA OUTCH
      AR
OUT2HS OUT2H                   BRA OUTCH
      AR
OUTS   AR                      BRA OUTCH
SAV    A012-3                 RTS
INEEE  SAV, DE, DEL           RTS
      A012-3, AR
OUTEEE SAV, DE, DEL           RTS
      A012-3, AR
OUTHR  A012-3, AR             JMP OUTEEE

```

These are most of the common routines which your programs can use and either end in an RTS or branch to another routine which ends in an RTS. For a brief description of these routines see the article titled "Software Power for Your M6800" in the October 1976 issue of INTERFACE AGE.

In case you are wondering why I choose to use the Decimal Adjust Instruction (DAI) in my memory test program it is because I wanted an increment that was not based on a binary value. Had I simply used a bit pattern incrementing from 00 to FF, I could not have detected addressing errors which were wrong by a factor of 256. You may also be thinking that it would be possible to save four bytes of memory if the two instructions which increment the pattern saved in the A register were changed from their present ADD A #\$01 to INC A. This seems logical on the face of it but won't work. It seems the INC A instruction does not affect the condition code register's carry or half-carry bits, both of which are necessary for the proper functioning of the decimal adjust feature.

One last comment. The major problem that I had with this program was fitting it into the available space. This task was only accomplished by a sneaky trick in the ERROUT routine. Normally writing the two error bytes would require twelve bytes of code. Six bytes for two STA A instructions to save the data. Three bytes for an LDX instruction to point to the data and three bytes for a JSR to OUT4HS to print them. I managed it in only 6. Two bytes to push both the A and B registers onto the stack. One byte to transfer the address of the stack pointer to the Index Register and three bytes for the OUT4HS call. Take a look at the ending address and see how easily six more bytes could have been absorbed! One of the Golden Rules of programming says: "Any program can be written in fewer instructions" but I'll leave that for some of you 6800 programming wizards.

If your memory has passed the memory test that you're currently using, and yet your programs seem to disappear or funny things happen to your data, you might try this program for a memory test in depth. I hope this program helps you keep your system in tip top shape.

PROGRAM ASSEMBLY LISTING

```

00010      *      NAM      MEMTEST
00020      *
00030      *
00040      *
00050      * PROGRAM NAME:      6800 MEMORY TEST

```

```

00060      * SYMBOLIC NAME:      MEMTEST
00070      * PROGRAMMER:      ED KEITH
00080      *
00090      * STORAGE REQUIRED: 128 BYTES (SCRATCHPAD IN 6800)
00100      * I/O INTERFACE:  HANDLED BY SUPPORT FIRMWARE
00110      * SUPPORT FIRMWARE:  MIKBUG - OR EQUIVALENT
00120      * CODED FOR:      SWTPC 6800 COMPUTER SYSTEM
00130
00140      *
00150      *
00160      * OPERATION:      LOAD LOW ADDRESS OF STORAGE TO
00170      *      BE TESTED AT A002-A003.  LOAD HIGH ADDRESS AT
00180      *      A004-A005.  SET PROGRAM COUNTER TO A073 AND
00190      *      RUN THE PROGRAM.
00200      *
00210      *      AN ASTERISK IS PRINTED FOR EACH
00220      *      PASS THROUGH THE MEMORY IN WHICH NO ERROR IS
00230      *      FOUND.  IF AN ERROR IS DISCOVERED, THIS FORM
00240      *      OF OUTPUT OCCURS:
00250      *      *102A 1715
00260      *
00270      *      A B C
00280      *      A = ADDRESS WHERE ERROR OCCURRED
00290      *      B = ACTUAL CONTENTS OF THE BYTE
00300      *      C = THE VALUE THAT SHOULD HAVE BEEN THERE
00310      *
00320      *      FROM THIS ERROR YOU COULD ASSUME THAT BIT 1 IS
00330      *      BAD OR THAT AN ADDRESS LINE SHORT IS MAKING
00340      *      ADDRESS 102A RESPOND WHEN ADDRESS 102C WAS
00350      *      PLACED ON THE ADDRESS BUS.
00360      *
00370      *
00380      *
00390      * OPT 0
00400      * ORG  $A014
00410
00420      *
00430      * POINTERS TO MIKBUG ROUTINES
00440      *
00450      * CRLF EQU  $E19D  CARR. RET. & LINE FEED STRING
00460      * OUT4HS EQU $F1D1  PRINT SINGLE CHAR FROM A REG
00470      * PDATA1 EQU $E07E  PRINT 2 BYTES IN HEX, 16-LOC
00480      *
00490      *
00500      * POINTERS TO SCRATCHPAD RAM
00510      *
00520      * HIADDR EQU  $A004  HIGH END OF ADDRESS RANGE
00530      * LOADDR EQU  $A002  LOW END OF ADDRESS RANGE
00540      *
00550      * MEMORY LOAD LOOP
00560      *
00570      * LOOP1 STA A 0,X  STORC PATTERN
00580      *      CPX  HIADDR  PHASE 1 DONE?
00590      *      BEQ  CHECK1  JUMP IF YES
00600      *      INX  ADD A #501  ADD 1 TO THE STORAGE ADDRESS
00610      *      DAA  CONVERT TO BCD
00620      *      BRA  LOOP1
00630      *
00640      * MEMORY CHECK LOOP
00650      *
00660      * A021 B6 A07F CHECK1 LDA A PATTRN  AK = PATTERN
00670      * A024 FF A002 LDX  LOADDR  BK = LOW ADDRESS
00680      * A027 F6 00 LOOP2 LDA B 0,X  GET STOKED PATTERN
00690      * A029 11 CBA  ARE BOTH PATTERNS ALIKE
00700      * A02A 26 1E BNE  ERROUT  JUMP IF NOT
00710      * A02C BC A004 CHECK2 CPX  HIADDR  PHASE 2 DONE?
00720      * A02F 27 35 BEQ  RECYCL  JUMP IF YES
00730      * A031 0E INX  ADD 1 TO THE STORAGE ADDRESS
00740      * A032 BB 01 ADD A #501  ADD 1 TO THE PATTERN
00750      * A034 19 DAA  CONVERT TO BCD
00760      * A035 20 F0 BRA  LOOP2
00770      *
00780      * INITIALIZE THE PROGRAM START VECTOR
00790      *
00800      * A048 ORG  $A048
00810      * A048 A073 PSVECT FDB $START
00820      *
00830      * ERROR PRINT ROUTINE
00840      *
00850      * A04A FF A07D ERROUT STX  ERADDR  SAVE
00860      * A04D 34 PSH A  ERROR
00870      * A04E 37 PSH B  DATA
00880      * A04F CF F19D LDX  PRINT CARRIAGE
00890      * A052 BD E07E JSR  PDATA1  RETURN AND ASTERISK
00900      * A055 CE A07D LDX  PRINT ADDRESS
00910      * A058 BD E0C8 JSR  OUT4HS  OF ERROR
00920      * A05B 30 TSX  PRINT WAS AND
00930      * A05C BD E0C8 JSR  OUT4HS  SHOULD BE BYTES
00940      * A05F 33 PUL B  KESTORE
00950      * A060 32 PUL A  PROGRAM
00960      * A061 FE A07D LDX  ERADDR  REGISTERS
00970      * A064 20 C6 BRA  CHECK2  AND CONTINUE WITH TEST
00980      *
00990      * PRINT ASTERISK AND CHANGE PATTERN ROUTINE
01000      *
01010      *
01020      * A066 B6 2A RECYCL LDA A #'*  PRINT AN
01030      * A068 BD E1D1 JSR  OUT4HS  ASTERISK
01040      * A06B B6 A07F LDA A PATTRN  CHANGE
01050      * A06F BB 01 ADD A #501  THE PATTERN
01060      * A070 19 DAA  CONVERT TO BCD
01070      * A071 20 02 BRA  SAVEA
01080      *
01090      * ACTUAL PROGRAM START
01100      *
01110      * A073 B6 00 START LDA A #500  INITIALIZE
01120      * A075 B7 A07F SAVEA STA A PATTRN  THE PATTERN
01130      * A078 FE A002 LDX  LOADDR  BK = LOW ADDRESS
01140      * A07B 20 97 BRA  LOOP1
01150      *
01160      * PROGRAM STORAGE AREAS
01170      *
01180      * A07D 0002 ERADDR RMB 2  ADDRESS OF ERROR BYTE
01190      * A07F 0001 PATTRN RMB 1  BIT PATTERN
01200      *
01200      * END

```

TOTAL ERROKS 00000

OBJECT CODE

```

5000000004D54D5A45535420B5
511E011A700BCA0042706085B011920F3B6A07F7FEA002E60011261EBCA00429
510BA02F273508B011920F00C
511E048A073FFA07D3637CEE19DBDE07CEA07DBDE0C30BDE0C8332FEA00E
511DA0637D20C6662ABDE1D1B6A07FBB0119202860B7A07F7FEA002E2970E
59

```


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1702AL	256 x 8 Bit 1 us TS Eras Lo Pwr	7.00	NH0026CN	5 MHz Dual Mos Clock Driver	3.00	8080A	Super 8008	16.95
2704	512 x 8 Bit 450 ns TS Erasable	20.00	N8T20	Bi-Directional One Shot	4.00	Z80	CPU (3880)	39.95
2708	1024 x 8 Bit 450 ns TS Erasable	27.08	N8T26	Quad Bus Driver/Receiver	3.25	F8	CPU (3850)	19.95
3601	256 x 4 OC 70 ns	4.50	N8T97	Tri State Hex Buffer	1.45	CDP1802CD	CPU (RCA)	29.50
5203AQ	256 x 8 Bit 1 us TS Erasable	7.00	DM8098	Tri State Hex Inverter	1.00	DYNAMIC RAMS		
5204AQ	512 x 8 Bit 1 us TS Erasable	10.00	1488	RS232 Quad Line Driver	1.95	1103	1024 x 1 Bit 300 ns	1.50
82S23B	32 x 8 Bit 50 ns OC	4.00	3205	1-of-8 Decoder 18 ns Delay	6.20	2107B	4096 x 1 Bit 200 ns	4.50
82S129B	256 x 4 Bit 50 ns TS	4.25	D-3207A	Quad NAND to MOS Driver	2.50	2107B-4	4096 x 1 Bit 270 ns	4.00
8223B	32 x 8 Bit 50 ns OC	4.00	C-3404	6 Bit Latch 12 ns O/P Delay	3.95	4050NL	4096 x 1 Bit 300 ns	4.50
WAVEFORM GENERATOR			P-3408A	Tri State Hex MOS Sense Amp	6.75	4096	4096 x 1 Bit 300 ns	5.00
8038	VCO	4.50	P-4201	Clock Generator	4.95	MM5262	2048 x 1 Bit 365 ns	3.00
MC4024	Dual VCO	2.75	MM-5320	T V Camera Sync Generator	6.00	MM5270	4096 x 1 Bit 200 ns (18 Pin)	5.00
566	VCO-Function	2.00	MM-5369	Oscillator Pre-Scaler	2.00	5280	4096 x 1 Bit 200 ns (16 Pin)	6.00
CHARACTER GENERATORS			DM-8130	Ten Bit Comparator	2.25	STATIC RAMS		
2513	5x7 5 line Lower Case	6.75	DM-8131	6 Bit Comparator	2.35	21L02-1	1024 x 1 Bit 350 ns TS	1.58
2513	5x7 5 line Upper Case	6.75	DM-8831	4 Input AND NAND Tri State	2.50	31L01	16 x 4 Bit 110 ns OC	2.00
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MCM6571A	128 x 9 x 7 Downcount	10.80	DM-8835	Quad Tri State Transceiver (Inv)	2.50	2101	256 x 4 Bit 1 us TS	3.00
MC6572	128 x 9 x 7 ASCII Non-Shifted W/G	10.80	U A R T S			2102	1024 x 1 Bit 1 us TS	1.25
SHIFT REGISTERS			AY5-1013	(GI)	6.95	2102-1	1024 x 1 Bit 500 ns TS	1.50
1404AN	1024 x 1 Bit 2.5 MHz	3.00	TR-1602A	(WD)	6.95	2111A-4	256 x 4 Bit 450 ns TS (18 pin)	4.45
2505K	512 x 1 Bit 2.5 MHz	3.00	TMS-6011	(TI)	6.95	2112A-4	256 x 4 Bit 450 ns TS (16 pin)	3.00
STATIC			SUPPORT DEVICES			2501B	256 x 1 Bit 1 us	1.45
MM506	100 x 2 Bit	.89	3851	Program Storage Unit (F-8)	14.95	3107	256 x 1 Bit 80 ns OC	2.95
2509K	50 x 2 Bit 1.5 MHz	1.00	3853	Static Memory Interface (f-8)	14.95	4200A	4096 x 1 Bit 250 ns	13.75
2518B	32 x 6 Bit 2.0 MHz	3.95	3881	Parallel I/O Controller (Z-80)	15.95	74C89	16 x 4 Bit 280 ns TS	3.00
2533V	1024 x 1 Bit 1.5 MHz	2.00	3882	Counter Timer Circuit (Z-80)	15.95	74S201	256 x 1 Bit 50 ns TS	4.75
TMS3002	50 x 2 Bit 1.0 MHz	1.00	TMS5501	I/O Controller	24.99	91L02A	1024 x 1 Bit 500 ns TS	2.00
TMS3112	32 x 6 Bit 2.0 MHz	3.95	8212	8-Bit I/O Port	4.25	7489	16 x 4 Bit 60 ns OC	2.25
MM5058	1024 x 6 Bit 1.5 MHz (8 pin)	2.00	8214	Priority Interrupt Control	12.95	8225	16 x 4 Bit 50 ns OC	1.50
			8216	Bi-Directional Bus Driver	5.25	8599	15 x 4 Bit 50 ns TS	1.50
			8224	Clock, Generator & Driver	6.00	82509	64 x 9 Bit	11.00
			8228	System Controller & Bus Driver	9.25	FIFO		
			8238	System Controller & Bus Driver	8.20	3341A	64 x 4 Bit 1.0 MHz	6.75
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			8255	Programmable Peripheral Interface	12.00			
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			8259	Programmable Interrupt Controller	22.00			

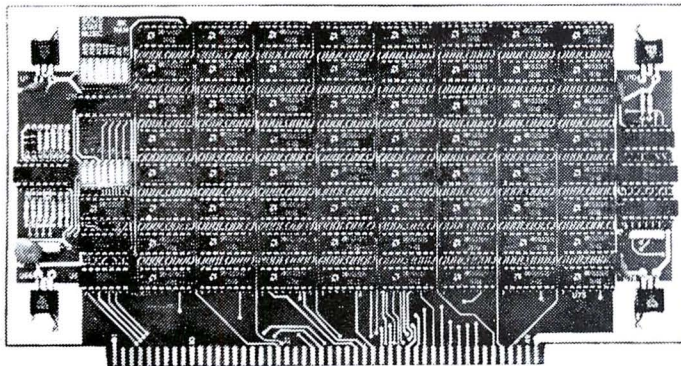
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28	Standard P C Tin	.60
28	Wire Wrap Tin	.95
28	Lo Pro (Open Frame) Tin	.50
40	Wire Wrap Tin	1.65

PIA TEST-IOTST

by William C. Wrary

Motorola Inc. — With Permission and Courtesy of Motorola's
M6800 User Group Library

FUNCTION: Test program to functionally verify the EXORciser I/O Module (or PIA's).

PARAMETERS: PIA's are connected back to back. Data transfers and control lines are then performed.

RESULTS: Normal operation results in printout of tests completed. Failures print address of routine not performed. List of failure addresses is printed before test begins.

HARDWARE CONFIGURATION: Requires only jumper on back of Module. Program explains how to install them.

MEMORY REQUIRED: 20 through XXX — enter at 20.

SOFTWARE SUPPORT: EXORciser EXbug 1.1.

ASSEMBLER/COMPILER: EXORciser Resident Assembler.

IOTST ASSEMBLY LISTING

```
00001      NAM      IOTST
00002      *      I/O MODULE TEST PROGRAM FOR THE EXORCISER.
00003      *      TESTS PIA'S FUNCTIONALLY. SEE END OF SOURCE FO
00004      *      OPERATION INSTRUCTIONS
00005      *      WRITTEN BY GENE CHALET. REVISED BY WCMRAY 2/10
```

```
00007      AAA9      E100      EQU      $AAA9
00008      AAAB      E101      EQU      $AAAB
00009      5555      E102      EQU      $5555
00010      5557      E103      EQU      $5557
00011      AAA8      E104      EQU      $AAA8
00012      AAAA      E105      EQU      $AAAA
00013      5554      E106      EQU      $5554
00014      5556      E107      EQU      $5556
00015      FFF8      E108      EQU      $FFF8
00016      FFF9      E109      EQU      $FFF9
```

```
00018      F9DC      G100      EQU      $F9DC      EXBUG'S OUTPUT ONE CHARACTER
00019      F564      G122      EQU      $F564      RETURN TO EXBUG
00020      F024      G123      EQU      $F024      EXBUG'S "PRINT A STRING"
```

```
00022 0020      ORG      $20
00023      OPT      0,N0G
00024 0020 8E 005B      LDS      $STACK
00025 0023 CE 037C      LDX      #G125      GET MESSAGE POINTER
00026 0026 BD F024      JSR      G123      PRINT MSG
00027 0029 7E 0062      JMP      START
```

00029 * INTERRUPT SERVICE ROUTINE FOR THE FOLLOWING TEST

```
00031 002C C6 04      G126      LDA      B      #$0004
00032 002E F7 AAA9      STA      B      E100
00033 0031 F7 AAAB      STA      B      E101
00034 0034 F7 5555      STA      B      E102
00035 0037 F7 5557      STA      B      E103
00036 003A F6 AAA8      LDA      B      E104
00037 003D F6 AAAA      LDA      B      E105
00038 0040 F6 5554      LDA      B      E106
00039 0043 F6 5556      LDA      B      E107
00040 0046 F6 005C      LDA      B      D100
00041 0049 5C          INC      B
00042 004A F7 005C      STA      B      D100
00043 004D 3B          RTI
```

```
00045 004E 000D      RMB      13
00046 005B 0001      STACK      RMB      1
00047 005C 0001      D100      RMB      1
00048 005D 0001      D101      RMB      1
```

```
00050 0062          ORG      $62
00051 0062 8E 005B      START      LDS      $STACK
00052 0065 86 00      LDA      A      #$0000
00053 0067 97 5C      STA      A      D100
```

00055 * SET INTERRUPT VECTOR

```
00057 0069 C6 2C          LDA      B      #G126
00058 006B B7 FFF8      STA      A      E108
00059 006E F7 FFF9      STA      B      E109
```

00061 * INITIALIZE PIA

```
00063 0071 C6 00          LDA      B      #$0000
00064 0073 F7 AAAA      STA      B      E105
00065 0076 C6 04          LDA      B      #$0004
00066 0078 F7 AAA9      STA      B      E100
00067 007B B7 AAA8      STA      A      E104
00068 007E F7 AAAB      STA      B      E101
00069 0081 F6 AAAA      LDA      B      E105
00070 0084 C1 FF          CMP      B      #$00FF
00071 0086 26 5C          BNE      G101
00072 0088 01          NOP
00073 0089 01          NOP
00074 008A 01          NOP
00075 008B 86 00          LDA      A      #$0000
00076 008D B7 AAA8      STA      A      E104
00077 0090 F6 AAAA      LDA      B      E105
00078 0093 C1 00          CMP      B      #$0000
```



```

00079 0095 26 4D      BNE    G101
00080 0097 01          NOP
00081 0098 86 AA      LDA    A    ##00AA
00082 009A B7 AAA8    STA    A    E104
00083 009D F6 AAAA    LDA    B    E105
00084 00A0 C1 AA      CMP    B    ##00AA
00085 00A2 26 40      BNE    G101
00086 00A4 01          NOP
00087 00A5 86 35      LDA    A    ##0055
00088 00A7 B7 AAA8    STA    A    E104
00089 00AA F6 AAAA    LDA    B    E105
00090 00AD C1 55      CMP    B    ##0055
00091 00AF 26 33      BNE    G101
00092 00B1 01          NOP
00093 00B2 86 30      LDA    A    ##0030
00094          *      COMPLETE TEST 0
00095 00B4 BD 035F    JSR     G102
00096 00B7 0E          CLI

```

```

00098          *      TEST 1 CB2 INTERRUPT

```

```

00100 00B8 C6 2C      LDA    B    ##002C
00101 00BA F7 AAA9    STA    B    E100
00102 00BD C6 0C      LDA    B    ##000C
00103 00BF F7 AAA8    STA    B    E101
00104          *      READ DATA A TO INTERRUPT

```

```

00106 00C2 B6 AAA8    LDA    A    E104
00107 00C5 01          NOP
00108 00C6 01          NOP
00109 00C7 D6 5C      LDA    B    D100
00110 00C9 C1 01      CMP    B    ##0001
00111 00CB 26 16      BNE    G103
00112 00CD 01          NOP
00113 00CE C6 2C      LDA    B    ##002C
00114 00D0 F7 AAA9    STA    B    E100
00115 00D3 C6 1C      LDA    B    ##001C
00116 00D5 F7 AAA8    STA    B    E101
00117          *      READ DATA B TO INTERRUPT

```

```

00119 00D8 F6 AAA8    LDA    B    E104
00120 00DB 01          NOP
00121 00DC 01          NOP
00122 00DD D6 5C      LDA    B    D100
00123 00DF C1 02      CMP    B    ##0002
00124 00E1 27 02      BEQ     G104
00125 00E3 3F          G103 SWI
00126 00E4 3F          G101 SWI
00127 00E5 86 31      G104 LDA    A    ##0031
00128          *      COMPLETE TEST 1

```

```

00130 00E7 BD 035F    JSR     G102
00131 00EA 01          NOP
00133          *      TEST 2 B>A

```

```

00135 00EB 86 00      LDA    A    ##0000
00136 00ED B7 AAA9    STA    A    E100
00137 00F0 B7 AAA8    STA    A    E101
00138 00F3 C6 FF      LDA    B    ##00FF
00139 00F5 F7 AAAA    STA    B    E105
00140 00F8 B7 AAA8    STA    A    E104
00141 00FB 86 04      LDA    A    ##0004
00142 00FD B7 AAA8    STA    A    E101
00143 0100 B7 AAA9    STA    A    E100
00144 0103 86 FF      LDA    B    ##00FF
00145 0105 B7 AAAA    STA    A    E105

```

```

00146 0108 F6 AAA8    LDA    B    E104
00147 010B C1 FF      CMP    B    ##00FF
00148 010D 26 5C      BNE    G105
00149 010F 01          NOP
00150 0110 01          NOP
00151 0111 86 00      LDA    A    ##0000
00152 0113 B7 AAAA    STA    A    E105
00153 0116 F6 AAA8    LDA    B    E104
00154 0119 C1 00      CMP    B    ##0000
00155 011B 26 4E      BNE    G105
00156 011D 01          NOP
00157 011E 86 AA      LDA    A    ##00AA
00158 0120 B7 AAAA    STA    A    E105
00159 0123 F6 AAA8    LDA    B    E104
00160 0126 C1 AA      CMP    B    ##00AA

```

```

00161 0128 26 41      BNE    G105
00162 012A 01          NOP
00163 012B 86 55      LDA    A    ##0055
00164 012D B7 AAAA    STA    A    E105
00165 0130 F6 AAA8    LDA    B    E104
00166 0133 C1 55      CMP    B    ##0055
00167 0135 26 34      BNE    G105
00168 0137 01          NOP
00169 0138 86 32      LDA    A    ##0032

```

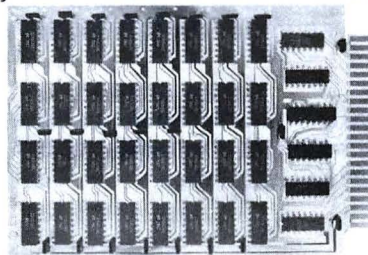
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00171          *      COMPLETE TEST 2
00173 013A BD 035F    JSR     G102
00174 013D 01          NOP

```

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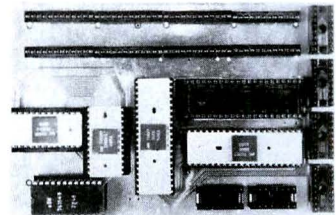
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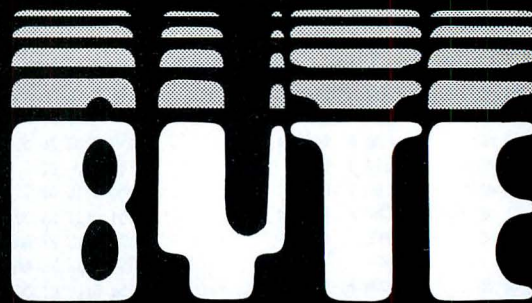
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```

00176      * TEST 3 CA2 INTERRUPT
00177 013E C6 0C LDA B #0000C
00178 0140 F7 AAA9 STA B E100
00179 0143 C6 2C LDA B #0002C
00180 0145 F7 AAAB STA B E101
00181      * WRITE DATA B TO INTERRUPT
00182 0148 F7 AAAA STA B E105
00183 014B 01 NOP
00184 014C 01 NOP
00185 014D D6 5C LDA B D100
00186 014F C1 03 CMP B #00003
00187 0151 26 17 BNE G106
00188 0153 01 NOP
00189 0154 C6 1C LDA B #0001C
00190 0156 F7 AAA9 STA B E100
00191 0159 C6 2C LDA B #0002C
00192 015B F7 AAAB STA B E101
00193      * WRITE DATA B TO INTERRUPT

```

```

00195 015E F7 AAAA STA B E105
00196 0161 01 NOP
00197 0162 01 NOP
00198 0163 D6 5C LDA B D100
00199 0165 C1 04 CMP B #00004
00200 0167 27 03 BEQ G107
00201 0169 01 NOP
00202 016A 3F G106 SWI
00203 016B 3F G105 SWI
00204 016C 86 33 G107 LDA A #00033

```

```

00206      * COMPLETE TEST 3
00207 016E BD 035F JSR G102
00208 0171 01 NOP
00210      * TEST 4-CA1 INTERRUPT
00211 0172 86 00 LDA A #00000
00212 0174 B7 AAAB STA A E104
00213 0177 B7 AAAA STA A E105
00214 017A C6 2D LDA B #0002D
00215 017C F7 AAA9 STA B E100
00216 017F C6 04 LDA B #00004
00217 0181 F7 AAAB STA B E101
00218      * READ DATA A TO INTERRUPT

```

```

00220 0184 F6 AAA8 LDA B E104
00221 0187 01 NOP
00222 0188 01 NOP
00223 0189 D6 5C LDA B D100
00224 018B C1 05 CMP B #00005
00225 018D 26 12 BNE G108
00226 018F 01 NOP
00227 0190 C6 2F LDA B #0002F
00228 0192 F7 AAA9 STA B E100
00229      * READ DATA A TO INTERRUPT

```

```

00231 0195 F6 AAA8 LDA B E104
00232 0198 01 NOP
00233 0199 01 NOP
00234 019A D6 5C LDA B D100
00235 019C C1 06 CMP B #00006
00236 019E 27 03 BEQ G109
00237 01A0 3F SWI
00238 01A1 3F G108 SWI
00239 01A2 01 NOP
00240 01A3 86 34 G109 LDA A #00034
00241      * COMPLETE TEST 4
00242 01A5 BD 035F JSR G102
00243 01A8 01 NOP
00245      * TEST 5-CB1 INTERRUPT
00247 01A9 C6 04 LDA B #00004
00248 01AB F7 AAA9 STA B E100
00249 01AE C6 2D LDA B #0002D
00250 01B0 F7 AAAB STA B E101
00251      * WRITE DATA B TO INTERRUPT
00252 01B3 F7 AAAA STA B E105

```

```

00253 01B6 01 NOP
00254 01B7 01 NOP
00255 01B8 D6 5C LDA B D100
00256 01BA C1 07 CMP B #00007
00257 01BC 26 12 BNE G110
00258 01BE 01 NOP
00259 01BF C6 2F LDA B #0002F
00260 01C1 F7 AAAB STA B E101
00261      * WRITE DATA B TO INTERRUPT
00262 01C4 F7 AAAA STA B E105
00263 01C7 01 NOP
00264 01C8 01 NOP
00265 01C9 D6 5C LDA B D100
00266 01CB C1 08 CMP B #00008
00267 01CD 27 03 BEQ G111

```

```

00268 01CF 3F SWI
00269 01D0 3F G110 SWI
00270 01D1 01 NOP
00271 01D2 86 35 G111 LDA A #00035
00272      * COMPLETE TEST 5
00273 01DA BD 035F JSR G102
00274 01DB 01 NOP
00275 01DE 01 NOP
00276 01DF 01 NOP
00277 01DA 01 NOP
00278 01DB 01 NOP
00279 01DC 01 NOP
00280 01DD 01 NOP
00281 01DE 01 NOP
00282 01DF 01 NOP

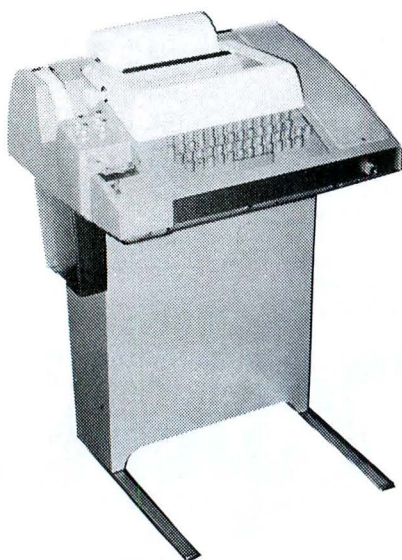
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7409N	23	74LS03N	110	LM382	1.60	CD4012	25	74C20	28	
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7430N	20	74LS123N	115	LM741CH	35	CD4017	100	74C49	1.15	MMS
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7448N	78	74LS157N	140	LM747N	110	CD4021	120	74C154	3.00	MMS
7449N	42	74LS162N	205	LM100A	1.27	CD4022	140	74C160	1.44	MMS
7450N	42	74LS162N	205	LM100S	1.27	CD4023	25	74C162	2.40	MMS
7451N	42	74LS162N	205	LM100T	2.00	CD4024	85	74C166	1.30	MMS
7452N	42	74LS162N	205	LM100T	2.00	CD4025	25	74C169	3.00	MMS
7453N	42	74LS162N	205	LM100T	2.00	CD4026	3.85	74C169	1.95	MMS
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7464N	42	74LS162N	205	LM100T	2.00	CD4037	1.35	89C02	75	MS
7465N	42	74LS162N	205	LM100T	2.00	CD4038	1.35	89C02	75	MS
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7468N	42	74LS162N	205	LM100T	2.00	CD4041	1.35	89C02	75	MS
7469N	42	74LS162N	205	LM100T	2.00	CD4042	1.35	89C02	75	MS
7470N	42	74LS162N	205	LM100T	2.00	CD4043	1.35	89C02	75	MS
7471N	42	74LS162N	205	LM100T	2.00	CD4044	1.35	89C02	75	MS
7472N	42	74LS162N	205	LM100T	2.00	CD4045	1.35	89C02	75	MS
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7475N	42	74LS162N	205	LM100T	2.00	CD4048	1.35	89C02	75	MS
7476N	42	74LS162N	205	LM100T	2.00	CD4049	1.35	89C02	75	MS
7477N	42	74LS162N	205	LM100T	2.00	CD4050	1.35	89C02	75	MS
7478N	42	74LS162N	205	LM100T	2.00	CD4051	1.35	89C02	75	MS
7479N	42	74LS162N	205	LM100T	2.00	CD4052	1.35	89C02	75	MS
7480N	42	74LS162N	205	LM100T	2.00	CD4053	1.35	89C02	75	MS
7481N	42	74LS162N	205	LM100T	2.00	CD4054	1.35	89C02	75	MS
7482N	42	74LS162N	205	LM100T	2.00	CD4055	1.35	89C02	75	MS
7483N	42	74LS162N	205	LM100T	2.00	CD4056	1.35	89C02	75	MS
7484N	42	74LS162N	205	LM100T	2.00	CD4057	1.35	89C02	75	MS
7485N	42	74LS162N	205	LM100T	2.00	CD4058	1.35	89C02	75	MS
7486N	42	74LS162N	205	LM100T	2.00	CD4059	1.35	89C02	75	MS
7487N	42	74LS162N	205	LM100T	2.00	CD4060	1.35	89C02	75	MS
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7489N	42	74LS162N	205	LM100T	2.00	CD4062	1.35	89C02	75	MS
7490N	42	74LS162N	205	LM100T	2.00	CD4063	1.35	89C02	75	MS
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7497N	42	74LS162N	205	LM100T	2.00	CD4070	1.35	89C02	75	MS
7498N	42	74LS162N	205	LM100T	2.00	CD4071	1.35	89C02	75	MS
7499N	42	74LS162N	205	LM100T	2.00	CD4072	1.35	89C02	75	MS
7500N	42	74LS162N	205	LM100T	2.00	CD4073	1.35	89C02	75	MS
7501N	42	74LS162N	205	LM100T	2.00	CD4074	1.35	89C02	75	MS
7502N	42	74LS162N	205	LM100T	2.00	CD4075	1.35	89C02	75	MS
7503N	42	74LS162N	205	LM100T	2.00	CD4076	1.35	89C02	75	MS
7504N	42	74LS162N	205	LM100T	2.00	CD4077	1.35	89C02	75	MS
7505N	42	74LS162N	205	LM100T	2.00	CD4078	1.35	89C02	75	MS
7506N	42	74LS162N	205	LM100T	2.00	CD4079	1.35	89C02	75	MS
7507N	42	74LS162N	205	LM100T	2.00	CD4080	1.35	89C02	75	MS
7508N	42	74LS162N	205	LM100T	2.00	CD4081	1.35	89C02	75	MS
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7511N	42	74LS162N	205	LM100T	2.00	CD4084	1.35	89C02	75	MS
7512N	42	74LS162N	205	LM100T	2.00	CD4085	1.35	89C02	75	MS
7513N	42	74LS162N	205	LM100T	2.00	CD4086	1.35	89C02	75	MS
7514N	42	74LS162N	205	LM100T	2.00	CD4087	1.35	89C02	75	MS
7515N	42	74LS162N	205	LM100T	2.00	CD4088	1.35	89C02	75	MS
7516N	42	74LS162N	205	LM100T	2.00	CD4089	1.35	89C02	75	MS
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7520N	42	74LS162N	205	LM100T	2.00	CD4093	1.35	89C02	75	MS
7521N	42	74LS162N	205	LM100T	2.00	CD4094	1.35	89C02	75	MS
7522N	42	74LS162N	205	LM100T	2.00	CD4095	1.35	89C02	75	MS
7523N	42	74LS162N	205	LM100T	2.00	CD4096	1.35	89C02	75	MS
7524N	42	74LS162N	205	LM100T	2.00	CD4097	1.35	89C02	75	MS
7525N	42	74LS162N	205	LM100T	2.00	CD4098	1.35	89C02	75	MS
7526N	42	74LS162N	205	LM100T	2.00	CD4099	1.35	89C02	75	MS
7527N	42	74LS162N	205	LM100T	2.00	CD4100	1.35	89C02	75	MS
7528N	42	74LS162N	205	LM100T	2.00	CD4101	1.35	89C02	75	MS
7529N	42	74LS162N	205	LM100T	2.00	CD4102	1.35	89C02	75	MS
7530N	42	74LS162N	205	LM100T	2.00	CD4103	1.35	89C02	75	MS
7531N	42	74LS162N	205	LM100T	2.00	CD4104	1.35	89C02	75	MS
7532N	42	74LS162N	205	LM100T	2.00	CD4105	1.35	89C02	75	MS
7533N	42	74LS162N	205	LM100T	2.00	CD4106	1.35	89C02	75	MS
7534N	42	74LS162N	205	LM100T	2.00	CD4107	1.35	89C02	75	MS
7535N	42	74LS162N	205	LM100T	2.00	CD4108	1.35	89C02	75	MS
7536N	42	74LS162N	205	LM100T	2.00	CD4109	1.35	89C02	75	MS
7537N	42	74LS162N	205	LM100T	2.00	CD4110	1.35	89C02	75	MS
7538N	42	74LS162N	205	LM100T	2.00	CD4111	1.35	89C02	75	MS
7539N	42	74LS162N	205	LM100T	2.00	CD4112	1.35	89C02	75	MS
7540N	42	74LS162N	205	LM100T	2.00	CD4113	1.35	89C02	75	MS
7541N	42	74LS162N	205	LM100T	2.00	CD4114	1.35	89C02	75	MS
7542N	42	74LS162N	205	LM100T	2.00	CD4115	1.35	89C02	75	MS
7543N	42	74LS162N	205	LM100T	2.00	CD4116	1.35	89C02	75	MS
7544N	42	74LS162N	205	LM100T	2.00	CD4117	1.35	89C02	75	MS
7545N	42	74LS162N	205	LM100T	2.00	CD4118	1.35	89C02	75	MS
7546N	42	74LS162N	205	LM100T	2.00	CD4119	1.35	89C02	75	MS
7547N	42	74LS162N	205	LM100T	2.00	CD4120	1.35	89C02	75	MS
7548N	42	74LS162N	205	LM100T	2.00	CD4121	1.35	89C02	75	MS
7549N	42	74LS162N	205	LM100T	2.00	CD4122	1.35	89C02	75	MS
7550N	42	74LS162N	205	LM100T	2.00	CD4123	1.35	89C02	75	MS
7551N	42	74LS162N	205	LM100T	2.00	CD4124	1.35	89C02	75	MS
7552N	42	74LS162N	205	LM100T	2.00	CD4125	1.35	89C02	75	MS
7553N	42	74LS162N	205	LM100T	2.00	CD4126	1.35	89C02	75	MS
7554N	42	74LS162N	205	LM100T	2.00	CD4127	1.35	89C02	75	MS
7555N	42	74LS162N	205	LM100T	2.00	CD4128	1.35	89C02	75	MS
7556N	42	74LS162N	205	LM100T	2.00	CD4129				

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CIRCLE INQUIRY NO. 86

00283 01E0 01	NOP	00321 0229 F6 5556	LDA B E107	00359 0269 01	NOP
00284 01E1 01	NOP	00322 022C C1 55	CHP B ##0055	00361	* TEST 8 B&A
00285 01E2 01	NOP	00323 022E 26 33	BNE G112	00363 026A 86 00	LDA A ##0000
00286 01E3 01	NOP	00324 0230 01	NOP	00364 026C B7 5555	STA A E102
00287 01E4 01	NOP	00325 0231 86 36	LDA A ##0036	00365 026F B7 5557	STA A E103
00288 01E5 01	NOP	00326	* COMPLETE TEST 6	00366 0272 C6 FF	LDA B ##00FF
00289	* INITIALIZE PIA	00327 0233 BD 035F	JSR G102	00367 0274 F7 5556	STA B E107
00290 01E6 C6 00	LDA B ##0000	00328 0236 0E	CLI	00368 0277 B7 5554	STA A E106
00291 01E8 F7 5555	STA B E102	00330	* TEST 7- CB2 INTERRUPT	00369 027A 86 04	LDA A ##0004
00292 01EB F7 5557	STA B E103	00331 0237 C6 2C	LDA B ##002C	00370 027C B7 5557	STA A E103
00293 01EE 86 FF	LDA A ##00FF	00332 0239 F7 5555	STA B E102	00371 027F B7 5555	STA A E102
00294 01F0 B7 5554	STA A E106	00333 023C C6 0C	LDA B ##000C	00372 0282 86 FF	LDA A ##00FF
00296	* TEST 6-A>B	00334 023E F7 5557	STA B E103	00373 0284 B7 5556	STA A E107
00297 01F3 F7 5556	STA B E107	00335	* READ DATA A TO INTERRUPT	00374 0287 F6 5554	LDA B E106
00298 01F6 C6 04	LDA B ##0004	00336 0241 B6 5554	LDA A E106	00375 028A C1 FF	CHP B ##00FF
00299 01F8 F7 5555	STA B E102	00337 0244 01	NOP	00376 028C 26 5C	BNE G115
00300 01FB B7 5554	STA A E106	00338 0245 01	NOP	00377 028E 01	NOP
00301 01FE F7 5557	STA B E103	00339 0246 D6 5C	LDA B D100	00378 028F 01	NOP
00302 0201 F6 5556	LDA B E107	00340 0248 C1 09	CHP B ##0009	00379 0290 86 00	LDA A ##0000
00303 0204 C1 FF	CHP B ##00FF	00341 024A 26 16	BNE G113	00380 0292 B7 5556	STA A E107
00304 0206 26 5B	BNE G112	00342 024C 01	NOP	00381 0295 F6 5554	LDA B E106
00305 0208 01	NOP	00343 024D C6 2C	LDA B ##002C	00382 0298 C1 00	CHP B ##0000
00306 0209 01	NOP	00344 024F F7 5555	STA B E102	00383 029A 26 4E	BNE G115
00307 020A 86 00	LDA A ##0000	00345 0252 C6 1C	LDA B ##001C	00384 029C 01	NOP
00308 020C B7 5554	STA A E106	00346 0254 F7 5557	STA B E103	00385 029D 86 AA	LDA A ##00AA
00309 020F F6 5556	LDA B E107	00347	* READ DATA A TO INTERRUPT	00386 029F B7 5556	STA A E107
00310 0212 C1 00	CHP B ##0000	00348 0257 F6 5554	LDA B E106	00387 02A2 F6 5554	LDA B E106
00311 0214 26 4D	BNE G112	00349 025A 01	NOP	00388 02A5 C1 AA	CHP B ##00AA
00312 0216 01	NOP	00350 025B 01	NOP	00389 02A7 26 41	BNE G115
00313 0217 86 AA	LDA A ##00AA	00351 025C D6 5C	LDA B D100	00390 02A9 01	NOP
00314 0219 B7 5554	STA A E106	00352 025E C1 0A	CHP B ##000A	00391 02AA 86 55	LDA A ##0055
00315 021C F6 5556	LDA B E107	00353 0260 27 02	BEQ G114	00392 02AC B7 5556	STA A E107
00316 021F C1 AA	CHP B ##00AA	00354 0262 3F	G113 SWI	00393 02AF F6 5554	LDA B E106
00317 0221 26 40	BNE G112	00355 0263 3F	G112 SWI	00394 02B2 C1 55	CHP B ##0055
00318 0223 01	NOP	00356 0264 86 37	G114 LDA A ##0037	00395 02B4 26 34	BNE G115
00319 0224 86 55	LDA A ##0055	00357	* COMPLETE TEST 7	00396 02B6 01	NOP
00320 0226 B7 5554	STA A E106	00358 0266 BD 035F	JSR G102	00397 02B7 86 38	LDA A ##0038
				00398	* COMPLETE TEST 8
				00399 02B9 BD 035F	JSR G102
				00400 02BC 01	NOP
				00402	* TEST 9 CA2 INTERRUPT
				00403 02BD C6 0C	LDA B ##000C
				00404 02BF F7 5555	STA B E102
				00405 02C2 C6 2C	LDA B ##002C
				00406 02C4 F7 5557	STA B E103
				00407	* WRITE DATA B TO INTERRUPT
				00408 02C7 F7 5556	STA B E107
				00409 02CA 01	NOP
				00410 02CB 01	NOP
				00411 02CC D6 5C	LDA B D100
				00412 02CE C1 0B	CHP B ##000B
				00413 02D0 26 17	BNE G116
				00414 02D2 01	NOP
				00415 02D3 C6 1C	LDA B ##001C
				00416 02D5 F7 5555	STA B E102
				00417 02D8 C6 2C	LDA B ##002C
				00418 02DA F7 5557	STA B E103
				00419	* WRITE DATA B TO INTERRUPT
				00420 02DD F7 5556	STA B E107
				00421 02E0 01	NOP
				00422 02E1 01	NOP
				00423 02E2 D6 5C	LDA B D100
				00424 02E4 C1 0C	CHP B ##000C
				00425 02E6 27 03	BEQ G117
				00426 02E8 01	NOP
				00427 02E9 3F	G116 SWI
				00428 02EA 3F	G115 SWI
				00429 02EB 86 39	G117 LDA A ##0039
				00430	* COMPLETE TEST 9
				00431 02ED BD 035F	JSR G102
				00432 02F0 01	NOP
				00434	* TEST A CA1 INTERRUPT
				00435 02F1 86 00	LDA A ##0000


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00436 02F3 B7 5554 STA A E106
00437 02F6 B7 5556 STA A E107
00438 02F9 C6 2D LDA B ##002D
00439 02FB F7 5555 STA B E102
00440 02FE C6 04 LDA B ##0004
00441 0300 F7 5557 STA B E103
00442 * READ DATA A TO INTERRUPT
00443 0303 F6 5554 LDA B E106
00444 0306 01 NOP
00445 0307 01 NOP
00446 0308 D6 5C LDA B D100
00447 030A C1 0D CMP B ##000D
00448 030C 26 12 BNE G118
00449 030E 01 NOP
00450 030F C6 2F LDA B ##002F
00451 0311 F7 5555 STA B E102
00452 * READ DATA A TO INTERRUPT
00453 0314 F6 5554 LDA B E106
00454 0317 01 NOP
00455 0318 01 NOP
00456 0319 D6 5C LDA B D100
00457 031B C1 0E CMP B ##000E
00458 031D 27 03 BEQ G119
00459 031F 3F SWI
00460 0320 3F G118 SWI
00461 0321 01 NOP
00462 0322 86 41 G119 LDA A ##0041
00463 * COMPLETE TEST A
00464 0324 BD 035F JSR G102
00465 0327 01 NOP

00467 * TEST B CB1 INTERRUPT
00468 0328 C6 04 LDA B #4
00469 032A F7 5555 STA B E102
00470 032D C6 2D LDA B ##2D
00471 032F F7 5557 STA B E103
00472 * WRITE DATA B TO INTERRUPT
00473 0332 F7 5556 STA B E107
00474 0335 01 NOP
00475 0336 01 NOP
00476 0337 D6 5C LDA B D100
00477 0339 C1 0F CMP B ##F
00478 033B 26 12 BNE G120
00479 033D 01 NOP
00480 033E C6 2F LDA B ##2F
00481 0340 F7 5557 STA B E103
00482 * WRITE DATA B TO INTERRUPT
00483 0343 F7 5556 STA B E107
00484 0346 01 NOP
00485 0347 01 NOP
00486 0348 D6 5C LDA B D100
00487 034A C1 10 CMP B ##10
00488 034C 27 03 BEQ G121
00489 034E 3F SWI
00490 034F 3F G120 SWI
00491 0350 01 NOP
00492 0351 86 42 G121 LDA A ##42
00493 * COMPLETE TEST B
00494 0353 BD 035F JSR G102
00495 0356 CE 036F LDX #G124 GET MESSAGE POINTER
00496 0359 BD F024 JSR G123 PRINT END OF TESTS
00497 035C 7E F564 JMP G122
00499 * PRINT SPACES AND TEST NO.
00501 035F 97 5D G102 STA A D101
00502 0361 86 20 LDA A ##20 GET CODE FOR "SPACE"
00503 0363 BD F9DC JSR G100 PRINT SPACE
00504 0366 BD F9DC JSR G100 ANOTHER
00505 0369 96 5D LDA A D101
00506 036B BD F9DC JSR G100
00507 036E 39 RTS
00509 036F 45 G124 FCC "END OF TESTS"
00510 037B 04 FCB 4

00512 037C 20 G125 FCC " I/O MODULE TEST PROGRAM F0
00513 03AF 0DOA FDB $DOA
00514 03B1 20 FCC " TESTS PIA'S FUNC
00515 03DD 0DOA FDB $DOA, $AOA
00516 03E1 20 FCC " ORIGINAL PROGRAM WRITTEN
00517 0414 0DOA FDB $DOA
00518 0416 20 FCC " REVISED 2/6/76 BY W
00519 0441 0DOA FDB $DOA, $AOA
00520 0445 20 FCC " TEST PROCEDURE"
00521 0456 0DOA FDB $DOA, $AOA
00522 045A 20 FCC / TURN ON ALL "DONT CARE" SWITCHES"
00523 047E 0DOA FDB $DOA
00524 0480 20 FCC / SET ADDRESS SWITCHES FOR PIA1 TO"
00525 04A9 0DOA FDB $DOA
00526 04AB 20 FCC / SET ADDRESS SWITCHES FOR PIA2 TO
00527 04D5 0DOA FDB $DOA
00528 04D7 20 FCC " CONNECT JUMPERS BETWEEN PA0-PA7 (
00529 0508 0DOA FDB $DOA
00530 050A 20 FCC " PBO-PB7 (PINS 10-17) ON PIA1 (
00531 0541 0DOA FDB $DOA
00532 0543 20 FCC " INSTALL JUMPERS BETWEEN CA1 (PIN
00533 0578 0DOA FDB $DOA
00534 057A 20 FCC " CB1 (PIN 18), AND CB2 (PIN 19)
00535 05AB 0DOA FDB $DOA
00536 05AD 20 FCC " CONNECTED TOGETHER)"
00537 05C7 0DOA FDB $DOA
00538 05C9 20 FCC " INSTALL SIMILAR JUMPERS ON PIA2"
00539 05EB 0DOA FDB $DOA
00540 05ED 20 FCC " CONNECT IRQA (PIN 38), AND IRQB (P
00541 0623 0DOA FDB $DOA
00542 0625 20 FCC " THE IRQ WIREWRAP POST ON THE MO
00543 064E 0DOA FDB $DOA
00544 0650 20 FCC " CONNECT IRQA AND IRQB OF PIA2 TO
00545 0682 0DOA FDB $DOA
00546 0684 20 FCC " INSTALL THE MODULE IN THE EXORCIS
00547 06AA 0DOA FDB $DOA
00548 06AC 20 FCC " TURN ON THE UNIT AND LOAD THIS TE
00549 06D7 0DOA FDB $DOA
00550 06D9 20 FCC " ENTER PROGRAM AT ADDRESS 0062. (6
00551 0701 0DOA FDB $DOA, $AOA
00552 0705 20 FCC " THERE ARE 0 THRU B TESTS AND AS E
00553 073E 0DOA FDB $DOA
00554 0740 20 FCC / NUMBER WILL BE PRINTED. IF ALL
00555 077A 0DOA FDB $DOA
00556 077C 20 FCC " BE PRINTED. IF ANY TEST FAILS,
00557 07B5 0DOA FDB $DOA
00558 07B7 20 FCC " PRINTED AND THE PROGRAM WILL R
00559 07EA 0DOA FDB $DOA, $AOA
00560 07EE 20 FCC " THE PROGRAM COUNTER WILL INDICATE
00561 082A 0DOA FDB $DOA, $AOA
00562 082E 20 FCC " PROGRAM COUNTER F
00563 0858 0DOA FDB $DOA
00564 085A 20 FCC " 00EE PIA1 HAS FAILED THE
00565 0891 0DOA FDB $DOA
00566 0893 20 FCC " 00EF PIA1 HAS FAILED THE
00567 08CA 0DOA FDB $DOA
00568 08CC 20 FCC " FROM PA0-PA7 TO PBO
00569 0901 0DOA FDB $DOA, $AOA
00570 0905 20 FCC " 0175 PIA1 HAS FAILED THE
00571 0938 0DOA FDB $DOA
00572 093D 20 FCC " 0176 PIA1 HAS FAILED THE
00573 0974 0DOA FDB $DOA
00574 0976 20 FCC " FROM PBO-PB7 TO PA0
00575 09AB 0DOA FDB $DOA
00576 09AD 20 FCC " 01AB PIA1 HAS FAILED THE
00577 09DB 0DOA FDB $DOA
00578 09DB 20 FCC " INTERRUPT TEST"
00579 09F7 0DOA FDB $DOA
00580 09F9 20 FCC " 01AC PIA1 HAS FAILED THE

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SOFTWARE APPLICATION

11E1035610270633F001864200636ACE037BDF0C2427EF564975D8620B0F9C0BE
11E10337180F90C596D0BFD90C39456442046F46285444535304202620280394
11E1038C202020620492F4F2040F4F45545455205445535420852044F7524189
11E10337402046F45220544845405584F5243495455206082020262028037
11E103C22020206202026202026202026202620455354552056494127532046EF
11E10300554E43544924F4E414C4C590B0800H2020202026202620262026204FD5
11E103F8524947494E414C2050524F475241402057524954544544E2042592080
11E1041347454E45204348414C45524E00B02026202620262026202620262026F5
11E104042E20202620254556495345420322F362F373620425920572E432E57H2
11E104495241590B0800H20262026204553542058524F43454455454500B00FF3
11E104064020202620455524E204F4E20414C4C2022444F4E542043415254523C
11E1047F205749544420553220E0B0262026202620262045542041444525533209
11E1049537495444384553204645F52205849413120544F4224414138220098
11E10485082026202635444204144445452533205749544438455446F60
11E1040552205494131220544F20262353534220B080202620434F4E4545368
11E104B54204945540545253204245545745454E2056413020504137262081
11E105650494553203292920414E4400B02026202620262026205420504720
11E1052137202659445E3320313020313729204F4E2050494131202638205AEF
11E10535C4F2030223120544F203120445543290B0820262026494E5354414CFD
11E105574C20495450455253204245545745454E2043413120265944E20A5
11E10572343292924313122026508494E20333929C00B02026202620262043B1
11E105804231202850494E203138929C42044034232028508494E2043139C0
11E10598292044F46205084941312E20414C4C00B0202620262026204F4E4EDF
11E105C34534545420544F474554484552290B082026202649545354414C7B
11E105D5E20354940494C41522049545045523204F4E2050494131200B02057
11E105F9202043F4E4E4543420495251412026508494E203338292C414E4648
11E1061420495251422026508494E203337292C204F462050849413120544F80B8
11E1062F082026202650484520495251205749525454521502050849453541E
11E106449244F4E20544845204DF445544C20B0820262026434F4E4E4543543E
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11E106B680820262026455524E204F4E20544845205054945420414E44204CF0F6
11E106D5144205448495320544525420544520541504500B082026204545528E2
11E106EEC2050524F475241402041542041444454255332038303632E20267E2
11E107673323847290B0800H2026202648455245204152403820265485267
11E10722552042205445534520414E4420415320445413482049532043F08
11E1074045084C45544442C2054484500B0820262026204E5540425522085
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11E1077322454E442044F46205445354220257494C4C00B0202620262026204C6
11E1078E4520505249454454442E20494620414E59205455354204541494C50
11E107953245484520524547495354455232057494C4C20424500B02026H3
11E107C7420262026505494E544420414E44205448452058524F47524140452
11E107DF2057494C4C20524545545524E20544F204584257E20B0800H20CC
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11E10815494E4449434154542054845204441494455524520415320464FC085
11E108304CF5753320B0800H20262058524F4752414020434F5545455247
11E108482026202620262026202620262026202620262044494C55524500B020F
11E1086620262026202630384545202620262026508494131204841532046415B
11E10881494C454420544845204434232026202645545525550584520545535415
11E1089C00B020262026202620262026202620262026202620504941312048415394
11E108B7204641494C4544205448452044415441205452414E3546452205429
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11E10923132048413204641494C4544205448452044413204945455252F8
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11E1098F7202646524F4020504320250423720544F20504130205041372024
11E1099A524553508453494554545C590B082026202620262026381341422028074
11E109C5202620265049413120484153204641494C45442054484520434131F1
11E109E020B08020262026202620262026202620

END*****

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As always this kit includes all parts, all sockets, and complete instructions for ease of assembly. Because of our past experience with our 4K kit we suggest that you order early. All orders will be shipped on a strict first come basis. Dealers inquiries welcome on this item. Kit includes Zilog Manual and all parts. Kit shipped with 2 MHZ crystals.
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Imsai and Altair 8080 plug in compatible. Uses low power static 21L02-1 500 ns. RAM'S. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated through PC Board.
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SONG - ANCHORS AWAY - NEVER ON SUNDAY
BRIDGE OVER RIVER QUI - CANDY MAN
Home Kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/Boat Kit DOES NOT include speaker.
Uses standard 8ohm PM speaker. Allow 4 weeks delivery on both kits.

Limited Quantity!

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We made a fantastic kit even better. Redesigned to take advantage of the latest advances in I.C. clock technology. Features: Litronix Dual 1/2" displays. Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). For P.C. Board add \$3.00; AC XFMR add \$1.50. Do not confuse with Non-Alarm kits sold by our competition!
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10 different values.
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1.5 Micro-Seconds Access Time.

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7410 - 9c
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7420 - 9c

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7440 - 9c
7437 - 10c
7438 - 10c
7451 - 9c
7474 - 16c
7475 - 24c
7486 - 16c

7493 - 26c
74121 - 22c
74123 - 32c
74151 - 9c
74155 - 22c
74193 - 35c
8233 - 35c
Intel - 1302 - 45c

1402 A Shift Regulator - 50c
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BOWL

by Bud Shamburger

```

1 / PROGRAM NAME "BOWL"
2 / MITS BASIC VERSION 4.0
3 / PROGRAMMED BY: BUD SHAMBURGER FEB 1977
4 / #27 RED OAK DR
5 / CONWAY, ARK 72032
20 / THIS IS A SIMULATED BOWLING GAME FOR UP TO FOUR PLAYERS. YOU PLAY
30 / 10 FRAMES. TO ROLL THE BALL, YOU SIMPLY TYPE "R". AFTER EACH
40 / ROLL, THE COMPUTER WILL SHOW YOU A DIAGRAM OF THE REMAINING PINS.
50 / "0" MEANS THE PIN IS DOWN. "+" MEANS IT IS STILL STANDING. THE
60 / COMPUTER WILL THEN GIVE YOU A ROLL ANALYSIS: GUTTER, STRIKE,
70 / SPARE, OR ERROR (ON SECOND BALL IF PINS STILL STANDING)
80 CLEAR 1000
90 DATA COME ON NOW... CONCENTRATE!!!!, YOU CAN DO BETTER THAN THAT!!!,
100 DATA YOU ROLL LIKE A WASH WOMAN!!!!, YOU SURE YOU AIN'T LEFT HANDED!!!,
110 DATA YOU MUST HAVE BLISTERS ON YOUR FINGERS!!!!,
120 DATA HOW OLD DID YOU SAY YOU WERE!!!!,
130 DATA O.K. GRANDA MA!!!!, YOU'LL DO BETTER IF YOU STAND UP!!!!,
140 DATA YOU WANNA BORROW MY CRUTCH!!!!, HAVE ANOTHER BEER!!!!,
150 DATA TAKE YOUR SUN GLASSES OFF- CAT!!!!,
160 DATA TRY KICKING UM OVER!!!!, NOW!!! AN'T YOU GOOD!!!!,
170 DATA YOU NEED A LONG STICK!!!!, TRY 2 BALLS NEXT TIME!!!!,
180 DATA DRIVE A TRUCK OVER UM!!!!,
190 DATA 9999
200 DIM C(15), A(100,6)
210 PRINT "WELCOME TO 'BUDS BOWLING ALLEY'"
220 PRINT "BRING YOUR FRIENDS"
230 PRINT "OKAY LET'S FIRST GET ACQUAINTED"
240 PRINT:PRINT
250 PRINT "WANT INSTRUCTION (Y OR N)"
260 INPUT Z$
270 IF Z$="Y" THEN 290
280 IF Z$="N" THEN 380
290 PRINT "THE GAME OF BOWLING TAKES MIND AND SKILL. DURING THE GAME"
300 PRINT "THE COMPUTER WILL KEEP SCORE. YOU MAY COMPETE WITH"
310 PRINT "OTHER PLAYERS (UP TO FOUR). YOU WILL BE PLAYING TEN FRAMES"
320 PRINT "ON THE PIN DIAGRAM '0' MEANS THE PIN IS DOWN. '+' MEANS THE"
330 PRINT "PIN IS STANDING. THE COMPUTER WILL SHOW YOUR SCORE AS THE"
340 PRINT "GAME PROGRESSES AND AT THE END OF THE GAME."
350 PRINT "YOU ARE GIVEN AN EXTRA 20 POINTS FOR STRIKES. OTHER THAN"
360 PRINT "THAT, THE SCORES ARE ACTUAL PIN COUNTS"
370 PRINT
380 PRINT "FIRST OF ALL... HOW MANY ARE PLAYING"
390 INPUT R
400 DIM P1(R)
410 PRINT
420 PRINT "VERY GOOD.... WORKING!"
430 FOR I=1 TO 100
440 FOR J=1 TO 6
450 A(I,J)=0
460 NEXT J
470 NEXT I
480 F=1
490 FOR P=1 TO R
500 M=0
510 B=1
520 N=0:Q=0
530 FOR I=1 TO 15
540 C(I)=0
550 NEXT I

560 / BALL GENERATOR
570 PRINT "PLAYER "P" ROLL YOUR 1ST BALL"
580 INPUT A$
590 K=0:D=0
600 FOR I=1 TO 20
610 X=INT((15-I)*RND(1)+1)
620 FOR J=1 TO 10
630 IF X<15*J THEN 650
640 NEXT J
650 C(15*J-X)=1
660 NEXT I

670 / PIN DIAGRAM
680 PRINT "PLAYER ";P;" FRAME ";F;" BALL ";B
690 PRINT
700 FOR I=1 TO 4
710 FOR J=1 TO 5-I
720 K=K+1
730 IF C(K)=1 THEN 760
740 L$=L$+" "
750 GOTO 770
760 L$=L$+"0 "
770 NEXT J
780 L$(I)=L$
790 L$=BK$
800 NEXT I
810 FOR I=1 TO 4
820 PRINT TAB(I);L$(I)
830 L$(I)="0"
840 NEXT I
850 / ROLL ANALYSIS
860 FOR I=1 TO 10
870 D=D+C(I)
880 NEXT I
890 IF D=N*10 THEN 930
900 PRINT "GUTTER!!!!"
910 READ X$: IF X$="9999" THEN RESTORE:GOTO 910
920 PRINT CHR$(7);CHR$(7);CHR$(7);CHR$(7);CHR$(7);CHR$(7)
930 IF B=1 AND D=10 THEN PRINT "STRIKE!!!!!!":Q=3:GOTO 1030
940 IF B=2 AND D=10 THEN PRINT:PRINT"SPARE!!!!!!":Q=2:GOTO 1030
950 IF B<2 AND D<10 THEN 1020
960 PRINT
970 PRINT "ERROR!!! "10-D" PINS LEFT"
980 G=1
990 READ X$: IF X$="9999" THEN RESTORE:GOTO 990
1000 PRINTCHR$(7);CHR$(7);CHR$(7);CHR$(7);CHR$(7);CHR$(7)
1010 PRINT X$:PRINT
1020 IF B<1 AND D<10 THEN 1030
1030 / STORAGE OF THE SCORES
1040 PRINT
1050 A(F*P,B)=D
1060 IFB=1THENP1(P)=P1(P)+D:PRINT"PINS DOWN = "D" YOUR SCORE = "P1(P)
1070 IFB=2THENP1(P)=P1(P)+(D-DB):PRINT"PINS DOWN = "D" YOUR SCORE = "P1(P):
DB=D
1080 IF B=2 THEN 1150
1100 B=2
1110 M=D
1120 IF Q=3 THEN D=D+10:GOTO 1030
1130 A(F*P,3)=D-M
1140 IF Q=0 THEN PRINT"PLAYER "P" ROLL YOUR 2ND BALL":GOTO 580
1150 A(F*P,3)=0
1160 NEXT P
1170 F=F+1
1180 IF F<11 THEN 490
1190 FOR P=1 TO R
1200 FOR I=1 TO 3
1210 FOR J=1 TO 10

1220 NEXT J
1230 NEXT I
1240 NEXT P
1250 FOR I=1 TO R
1260 PRINT "***** SCORES *****"
1270 PRINT
1280 PRINT "PLAYER ";I
1290 PRINT " ";P1(I)
1300 PRINT
1310 NEXT I
1320 PRINT "DO YOU WANT ANOTHER GAME"
1330 INPUT A$
1340 IF A$="Y" THEN 80
1350 END

```

Join the countdown for the Astronomy/Astrophysic Special appearing in the August issue of INTERFACE AGE.

... TO BOLDLY GO where no microcomputer magazine has gone before: to the stars and the planets. That is **INTERFACE AGE's** mission for August 1977. Deep space system technologies are switching from macro- to mini- and microcomputers and the world of the stargazer is going **BASIC**. Don't miss this colorful and informative **ASTRONOMY** and **ASTROPHYSICS** Special in our August issue. **INTERFACE AGE** is the microcomputer magazine which brought you exciting reports on **ROBOTICS** and **BIONICS**. Come aboard and couple your micro to this adventurous **uplink**.

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74LS03	28	74LS34	33	74LS94	57	74LS160	1.02	74LS251	75
74LS04	29	74LS35	33	74LS95	57	74LS161	1.02	74LS252	75
74LS05	29	74LS36	33	74LS96	57	74LS162	1.02	74LS253	75
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74LS10	28	74LS41	33	74LS101	57	74LS167	1.02	74LS258	75
74LS11	28	74LS42	33	74LS102	57	74LS168	1.02	74LS259	75
74LS12	28	74LS43	33	74LS103	57	74LS169	1.02	74LS260	75
74LS13	28	74LS44	33	74LS104	57	74LS170	1.02	74LS261	75
74LS14	1.02	74LS45	33	74LS105	57	74LS171	1.02	74LS262	75
74LS15	28	74LS46	33	74LS106	57	74LS172	1.02	74LS263	75
74LS16	28	74LS47	33	74LS107	57	74LS173	1.02	74LS264	75
74LS17	28	74LS48	33	74LS108	57	74LS174	1.02	74LS265	75
74LS18	28	74LS49	33	74LS109	57	74LS175	1.02	74LS266	75
74LS19	28	74LS50	33	74LS110	57	74LS176	1.02	74LS267	75
74LS20	28	74LS51	33	74LS111	57	74LS177	1.02	74LS268	75
74LS21	28	74LS52	33	74LS112	57	74LS178	1.02	74LS269	75
74LS22	28	74LS53	33	74LS113	57	74LS179	1.02	74LS270	75
74LS23	28	74LS54	33	74LS114	57	74LS180	1.02	74LS271	75
74LS24	28	74LS55	33	74LS115	57	74LS181	1.02	74LS272	75
74LS25	28	74LS56	33	74LS116	57	74LS182	1.02	74LS273	75
74LS26	28	74LS57	33	74LS117	57	74LS183	1.02	74LS274	75
74LS27	28	74LS58	33	74LS118	57	74LS184	1.02	74LS275	75
74LS28	28	74LS59	33	74LS119	57	74LS185	1.02	74LS276	75
74LS29	28	74LS60	33	74LS120	57	74LS186	1.02	74LS277	75
74LS30	28	74LS61	33	74LS121	57	74LS187	1.02	74LS278	75
74LS31	28	74LS62	33	74LS122	57	74LS188	1.02	74LS279	75
74LS32	28	74LS63	33	74LS123	57	74LS189	1.02	74LS280	75
74LS33	28	74LS64	33	74LS124	57	74LS190	1.02	74LS281	75
74LS34	28	74LS65	33	74LS125	57	74LS191	1.02	74LS282	75
74LS35	28	74LS66	33	74LS126	57	74LS192	1.02	74LS283	75
74LS36	28	74LS67	33	74LS127	57	74LS193	1.02	74LS284	75
74LS37	28	74LS68	33	74LS128	57	74LS194	1.02	74LS285	75
74LS38	28	74LS69	33	74LS129	57	74LS195	1.02	74LS286	75
74LS39	28	74LS70	33	74LS130	57	74LS196	1.02	74LS287	75
74LS40	28	74LS71	33	74LS131	57	74LS197	1.02	74LS288	75
74LS41	28	74LS72	33	74LS132	57	74LS198	1.02	74LS289	75
74LS42	28	74LS73	33	74LS133	57	74LS199	1.02	74LS290	75
74LS43	28	74LS74	33	74LS134	57	74LS200	1.02	74LS291	75
74LS44	28	74LS75	33	74LS135	57	74LS201	1.02	74LS292	75
74LS45	28	74LS76	33	74LS136	57	74LS202	1.02	74LS293	75
74LS46	28	74LS77	33	74LS137	57	74LS203	1.02	74LS294	75
74LS47	28	74LS78	33	74LS138	57	74LS204	1.02	74LS295	75
74LS48	28	74LS79	33	74LS139	57	74LS205	1.02	74LS296	75
74LS49	28	74LS80	33	74LS140	57	74LS206	1.02	74LS297	75
74LS50	28	74LS81	33	74LS141	57	74LS207	1.02	74LS298	75
74LS51	28	74LS82	33	74LS142	57	74LS208	1.02	74LS299	75
74LS52	28	74LS83	33	74LS143	57	74LS209	1.02	74LS300	75
74LS53	28	74LS84	33	74LS144	57	74LS210	1.02	74LS301	75
74LS54	28	74LS85	33	74LS145	57	74LS211	1.02	74LS302	75
74LS55	28	74LS86	33	74LS146	57	74LS212	1.02	74LS303	75
74LS56	28	74LS87	33	74LS147	57	74LS213	1.02	74LS304	75
74LS57	28	74LS88	33	74LS148	57	74LS214	1.02	74LS305	75
74LS58	28	74LS89	33	74LS149	57	74LS215	1.02	74LS306	75
74LS59	28	74LS90	33	74LS150	57	74LS216	1.02	74LS307	75
74LS60	28	74LS91	33	74LS151	57	74LS217	1.02	74LS308	75
74LS61	28	74LS92	33	74LS152	57	74LS218	1.02	74LS309	75
74LS62	28	74LS93	33	74LS153	57	74LS219	1.02	74LS310	75
74LS63	28	74LS94	33	74LS154	57	74LS220	1.02	74LS311	75
74LS64	28	74LS95	33	74LS155	57	74LS221	1.02	74LS312	75
74LS65	28	74LS96	33	74LS156	57	74LS222	1.02	74LS313	75
74LS66	28	74LS97	33	74LS157	57	74LS223	1.02	74LS314	75
74LS67	28	74LS98	33	74LS158	57	74LS224	1.02	74LS315	75
74LS68	28	74LS99	33	74LS159	57	74LS225	1.02	74LS316	75
74LS69	28	74LS100	33	74LS160	1.02	74LS226	1.02	74LS317	75
74LS70	28	74LS101	33	74LS161	1.02	74LS227	1.02	74LS318	75
74LS71	28	74LS102	33	74LS162	1.02	74LS228	1.02	74LS319	75
74LS72	28	74LS103	33	74LS163	1.02	74LS229	1.02	74LS320	75
74LS73	28	74LS104	33	74LS164	1.02	74LS230	1.02	74LS321	75
74LS74	28	74LS105	33	74LS165	1.02	74LS231	1.02	74LS322	75
74LS75	28	74LS106	33	74LS166	1.02	74LS232	1.02	74LS323	75
74LS76	28	74LS107	33	74LS167	1.02	74LS233	1.02	74LS324	75
74LS77	28	74LS108	33	74LS168	1.02	74LS234	1.02	74LS325	75
74LS78	28	74LS109	33	74LS169	1.02	74LS235	1.02	74LS326	75
74LS79	28	74LS110	33	74LS170	1.02	74LS236	1.02	74LS327	75
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74LS82	28	74LS113	33	74LS173	1.02	74LS239	1.02	74LS330	75
74LS83	28	74LS114	33	74LS174	1.02	74LS240	1.02	74LS331	75
74LS84	28	74LS115	33	74LS175	1.02	74LS241	1.02	74LS332	75
74LS85	28	74LS116	33	74LS176	1.02	74LS242	1.02	74LS333	75
74LS86	28	74LS117	33	74LS177	1.02	74LS243	1.02	74LS334	75
74LS87	28	74LS118	33	74LS178	1.02	74LS244	1.02	74LS335	75
74LS88	28	74LS119	33	74LS179	1.02	74LS245	1.02	74LS336	75
74LS89	28	74LS120	33	74LS180	1.02	74LS246	1.02	74LS337	75
74LS90	28	74LS121	33	74LS181	1.02	74LS247	1.02	74LS338	75
74LS91	28	74LS122	33	74LS182	1.02	74LS248	1.02	74LS339	75
74LS92	28	74LS123	33	74LS183	1.02	74LS249	1.02	74LS340	75
74LS93	28	74LS124	33	74LS184	1.02	74LS250	1.02	74LS341	75
74LS94	28	74LS125	33	74LS185	1.02	74LS251	1.02	74LS342	75
74LS95	28	74LS126	33	74LS186	1.02	74LS252	1.02	74LS343	75
74LS96	28	74LS127	33	74LS187	1.02	74LS253	1.02	74LS344	75
74LS97	28	74LS128	33	74LS188	1.02	74LS254	1.02	74LS345	75
74LS98	28	74LS129	33	74LS189	1.02	74LS255	1.02	74LS346	75
74LS99	28	74LS130	33	74LS190	1.02	74LS256	1.02	74LS347	75
74LS100	28	74LS131	33	74LS191	1.02	74LS257	1.02	74LS348	75
74LS101	28	74LS132	33	74LS192	1.02	74LS258	1.02	74LS349	75
74LS102	28	74LS133	33	74LS193	1.02	74LS259	1.02	74LS350	75
74LS103	28	74LS134	33	74LS194	1.02	74LS260	1.02	74LS351	75
74LS104	28	74LS135	33	74LS195	1.02	74LS261	1.02	74LS352	75
74LS105	28	74LS136	33	74LS196	1.02	74LS262	1.02	74LS353	75
74LS106	28	74LS137	33	74LS197	1.02	74LS263	1.02	74LS354	75
74LS107	28	74LS138	33	74LS198	1.02	74LS264	1.02	74LS355	75
74LS108	28	74LS139	33	74LS199	1.02	74LS265	1.02	74LS356	75
74LS109	28	74LS140	33	74LS200	1.02	74LS266	1.02	74LS357	75
74LS110	28	74LS141	33	74LS201	1.02	74LS267	1.02	74LS358	75
74LS111	28	74LS142	33	74LS202	1.02	74LS268	1.02	74LS359	75
74LS112	28	74LS143	33	74LS203	1.02	74LS269	1.02	74LS360	75
74LS113	28	74LS144	33	74LS204	1.02	74LS270	1.02	74LS361	75
74LS114	28	74LS145	33	74LS205	1.02	74LS271	1.02	74LS362	75
74LS115	28	74LS146	33	74LS206	1.02	74LS272	1.02	74LS363	75
74LS116	28	74LS147	33	74LS207	1.02	74LS273	1.02	74LS364	75
74LS117	28	74LS148	33	74LS208	1.02	74LS274	1.02	74LS365	75
74LS118	28	74LS149	33	74LS209	1.02	74LS275	1.02	74LS366	75
74LS119	28	74LS150	33	74LS210	1.02	74LS276	1.02	74LS367	75
74LS120	28	74LS151	33	74LS211	1.02	74LS277	1.02	74LS368	75
74LS121	28	74LS152	33	74LS212	1.02	74LS278	1.02	74LS369	75
74LS122	28	74LS153	33	74LS213	1.02	74LS279	1.02	74LS370	75
74LS123	28	74LS154	33	74LS214	1.02	74LS280	1.02	74LS371	75
74LS124	28	74LS155	33	74LS215	1.02	74LS281	1.02	74LS372	75
74LS125	28	74LS156	33	74LS216	1.02	74LS282	1.02	74LS373	75
74LS126	28	74LS157	33	74LS217	1.02	74LS283	1.02	74LS374	75
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WANTED: Mini-Processor Computer like SOL 20 or IMSAI 8080 with 24K memory. Peripherals such as printer, CRT or adapted TV, Floppy Disk System, Alpha-Numeric Keyboard or other components that can be used with record keeping and teaching in Youth Oriented Ministry of Small Church. Would appreciate this as a donation. Will give a tax deductible receipt in letter form. You determine the value for tax purposes. Write Rev. Jack Weaver, Pastor; Palmetto Bible Chapel, 16255 S.E. 82 Avenue, Perrine, Florida 33157 or call (305) 238-4837.

FOR SALE: SPHERE BOARDS; CRT/1, CPU/2, 2 Memory (16K, 4K), SIM with dual cassette interface. Contact: Richard Likwartz, (307) 362-5316.

FOR SALE: Sphere 310A microcomputer. M6800 CPU, cassette interface, video interface, and ASCII keyboard. Factory condition. 4K memory. Up and running EPROM monitor (editor, assembler, and debugger). Needs only audio cassette deck and monitor for complete system. Originally \$1500. Asking \$750. Jerry Katcher, 303 Sample Bridge Rd., Mechanicsburg, PA 17055.

FOR SALE: KSR-33. Newly re-conditioned but without case — \$350 firm, plus shipping. Jim Shrider, 5628 Fox-

glove Ln., Cincinnati, OH 45239. (513) 542-7127 evenings.

WANT back issues of INTERFACE AGE. Vol. 1, Nos. 1-4 and 7. M. Vogt, 206 Robinhood, San Antonio, TX 78209.

FOR SALE: Viatron Print Robot \$175 (driver/interface not included). Compact solenoid unit clips to selectric typewriter to strike keys, no internal mods to typewriter. (201) 451-2905 eves., wkends. G. Lyons. Also adaptable to some non-selectrics, incl. coronomatic.

FOR SALE: Internal Intercept Jr. single-board computer with RAM, ROM monitor, keyboard and LED display, with plug-in serial 20-ma teletype or RS-232C interface and plug-in two-channel output interface. New cost \$360, will accept highest offer over \$225. Peter Stark, P.O. Box 209, Mt. Kisco, NY 10549. (914) 241-1027.

FOR SALE: IBM Selectric I/O-writer, new condition, with ASCII-coded S100 interface and power-supply by Micromation Inc., \$1,195 or offer. (415) 843-7234.

FOR SALE: Tektronix 511A scope \$50.00, Heath IO-102 scope \$95.00, HP 524D freq. counter \$45.00, Marconi 20-300MHz oscillator \$25.00. S. Lei, P.O. Box 5312, Fargo, N.D. 58102.

FOR SALE: Sphere 330 system (based on 6800) with 20k RAM, 1.25K PROM (PDS-V3N monitor), two KC cassette inter-

faces, RS-232 or TTY, spare PIA port, ASCII keyboard, 16x32 TV interface, enclosed in low profile metal cabinet. Extensive documentation, much software. Asking \$1500.00. J. M. Luce, 1020 University Bay Dr., Madison, WI 53705, (608) 271-3333 weekdays.

FOR SALE: ALTAIR 8800B complete with 8 installed sockets/guides; MITS 2SIO brd; 2 Pro Tech 8KRA brds (16K total); doc. New over \$2060. This system just as good \$1780 (incl. ship.) Working without fault for 6 mths. Also have a TV DAZZLER fully operational for sale separately. Scott Plunkett, 1025 Kaimoku Pl., Hon., HI 96821. (808) 373-9137.

WANTED: to know what mini/micro-computer you have for sale. Especially interested in Altair™ or Imsai™ or other 8080 or Z-80 based CPU. Also want video terminal interface and video terminal information. Must have all manuals. Richard A. Peterson, 1329 Grace #4, Santa Ana, CA 92701.

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CALENDAR

VECTORED FROM PAGE 12

July 11 The Permian Basin Computer Group in the Midland area meets the second Monday of each month at 7:30 PM in the Student Union Building on the Midland College campus. For additional information write John Rabenaldt, Box 3912, Odessa, TX 79760.

July 12 Arizona Computer Society meets on Tuesday at 7:00, room 226, DeVry Institute, 4702 N. 24th St., Phoenix, AZ 85063.

July 16 North Texas Computer Hobbyist Group has its meetings at 1 PM in the University Hall, Room 108, located at the University of Texas, Arlington, TX. Call (817) 244-1013 for more information.

July 16 Winnipeg Microcomputer Club will be meeting at Red River Community College, Room A109, at 2 PM.

July 17 Pittsburgh Area Computer Club. for information on meeting time and place, contact Fred Kit-

man, (412) 931-3800, or Harry Kohman, (412) 931-5866, evenings.

July 20 Northwest Computer Club will be meeting at 7 PM at the Pacific Science Center, Room 200, located in North Seattle, WA.

July 20 Homebrew Computer Club will be meeting at the Stanford Linear Accelerator Center Auditorium at 7 PM in Menlo Park, CA. Call Bob Reiling at (415) 967-6754 for more details.

July 21 New York Amateur Computer Club will meet at 7 PM. Call Bob Schwartz for meeting place at (212) 663-5549.

July 24 Chicago Area Computer Hobbyist Exchange (CACHE) will meet at 12 PM in the NIGAS Bldg. cafeteria. The NIGAS Bldg. is located on Schermer Rd., in Glenview, IL. Write CACHE, P.O. Box 36, Vernon Hills, IL 60061 for complete details. Or call (312) 620-1671.

July 25 Minnesota Computer Society will hold its meeting at 7:30 PM in the library in Brooklyn

Center Minnesota. For further information write: Minnesota Computer Society, P.O. Box 35317, Minneapolis, MN 55435.

July 26 Sacramento Microcomputer Users' Group will hold its meeting at 7:30 PM at the SMUD Training Bldg., All-purpose Room. SMUD is located on 59th Street between S and R. For further information write: SMUG, P.O. Box 161513, Sacramento, CA 95816.

July 28 Space Coast Microcomputer Club will hold its meeting at 7:30 PM at the Merritt Island Library, Merritt Island, FL. Contact Ray Lockwood at (305) 452-2159 for details.

July 29 Washington Amateur Computer Society has scheduled to have its meeting held at the Catholic University of America, St. Johns Hall. Located at Michigan and Harewood Aves., in Washington D.C. Contact Bill Stewart at (202) 722-0210 for club details between the hours of 10 AM and 12 PM.

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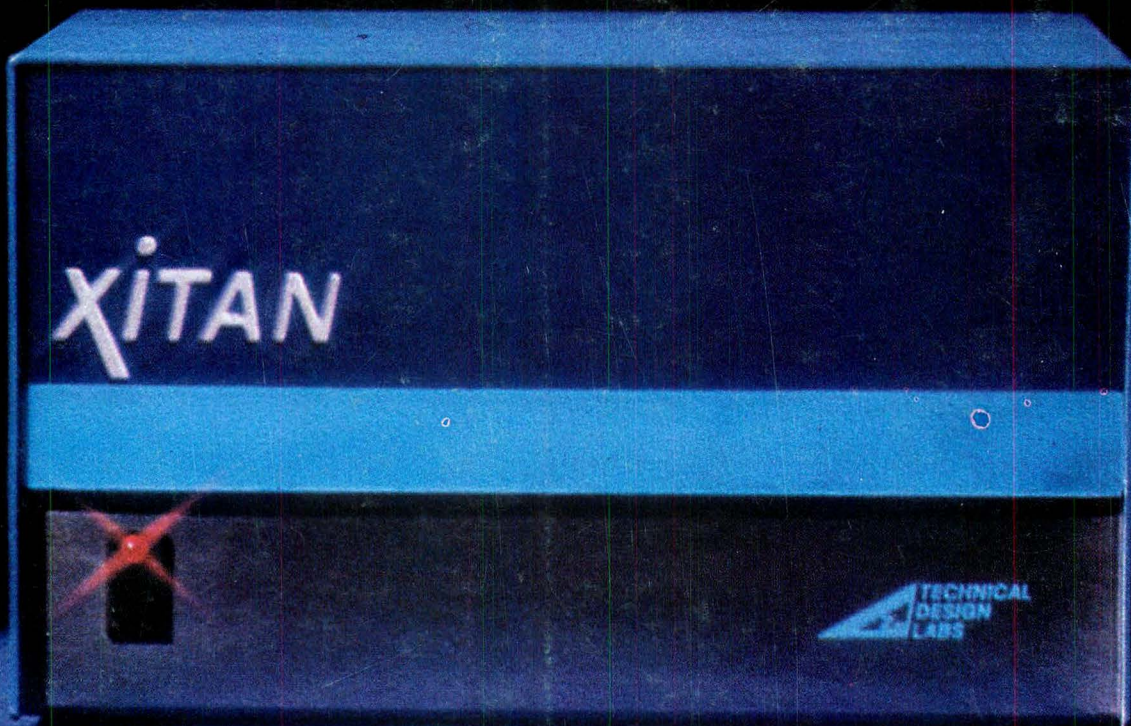
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